PLC2011B1

PROGRAMMABLE CONTROLLER / ALARM OPERATION VIA THE INTERNET USING A PC OR ANDROID

ENCRYPTED DATA TRANSMISSION

BUILT-IN ASTRONOMICAL TIMER

1. INTRODUCTION

The devices purpose:

- The alarm unit is equipped with 21 resistance recognizing inputs which can be connected to 84 sensors. The unit is programmed, operated and controlled via the internet using a PC or an Android mobile device (phones, smartphones, tablets) in a way ensuring absolute safety.
- Remote control or, after programming, automatic operation without the user's constant supervision.
- 4 open collector outputs and 2 +12V power supply outputs
- option to expand the number of inputs/outputs using a maximum of 2 input/output DS 2408 modules on 1-Wire bus. They can be added in groups of eight so you can have 8 or 16 additional 1-Wire inputs or 8 or 16 additional 1-Wire outputs.
- 1-Wire bus with the ability to connect 32 DALLAS digital thermometers, pressure, humidity or insulation sensors etc.
- 16 built-in thermostats with heating /cooling options or 8 differential thermostats

1.1. About the software

The PLC2011B1 operating software for Windows does not have any functions that would spy on the user. It does not steal data, connect to unknown internet addresses or to the manufacturer or the software's author. No data are saved to the Windows registry system and all settings and configuration files are created only in the folder containing the *.exe executable file. The software does not automatically check for updates so the user's IP address and location are not logged. There are no functions of this type.

Using this software is extremely safe, especially when you want to control an alarm while being far away from it. You can expose the relay's IP address to the public address pool or do a port redirection at the router without any concern that the device will be broken into.

The device cannot be broken into because it has no operating system able to execute a code received from the outside. This problem does not exist at all due to how the device is built.

When running the software on Windows 7 you should be logged in as the administrator when you want to edit the time server or firewall settings.

1.2. A few words about safety

The device was designed with a lot of attention put on safety. An advanced, military strength cryptographic system protects data from being intercepted during transmission and used again, prevents unauthorized access to the device by people trying to impersonate the rightful user. From now on you can safely arm or disarm your alarm even on the other side of the planet without fear that an intruder will intercept the Internet transmission and use it to break into your house.

The safety system is based on many factors

For the communication with the device to start you need to enter a long password. You do this either using your keyboard or using your mouse and a virtual keyboard on your screen. This is a means of defense against spy-software, especially programs which register keystroke.

The entered password is not transmitted through the Internet. This password is only used to mathematically generate a substitutionary password using the SHA256 hash function.

This digest is also not transmitted through the Internet. The digest is used to encrypt the data between the user's computer and the device, and is automatically wiped from the computer's memory before the software is shut down.

The long password you entered is overwritten in the memory when approved and a memory dump after the software is closed will not reveal our secrets.

The device has a digest of an identical password, entered to it's own memory while it was being configured through USB but does not have a password per se. It also does not have a function reading anything from the device's memory that could reveal the password or it's digest. It is impossible to extract the password through USB, the Internet or from electronic elements of the device. You can only change the password personally after connecting the device to your computer by an USB cable and entering the 12 byte PIN code which prevents unauthorized password change through USB.

During the first phase, the password goes through a one way hashing function SHA256. This is a cryptographic function which changes any character string to a so called digest that is 256 bits long (32 bytes). This digest will be used as a password to the actual encryption algorithm AES-256, which requires a 256 bit long password.

Before a packet of data is encrypted, a 128 bit random number is generated, precisely the same length as the block of data that is being processed by the AES-256 algorithm. From this moment, a packet of data with commands transmitted to the device is formed. Placed in this packet is also our computer's current system time with no more than a 15 second difference between the device and the computer. The packet is then put through the XOR function with the generated random number. The random number is generated separately for every packet. Next, the random number and the packet are encrypted with the 256 bit digest. You say that a packet like this is time stamped and encrypted. Additionally, every packet looks different thanks to the random numbers and is only valid for 15 seconds after being formed. As the device has it's own independent real-time clock, the communication will work if the time stamp entered in the transmitted data packet before encryption is the same (the difference can be up to 15 seconds) in the computer and in the device.

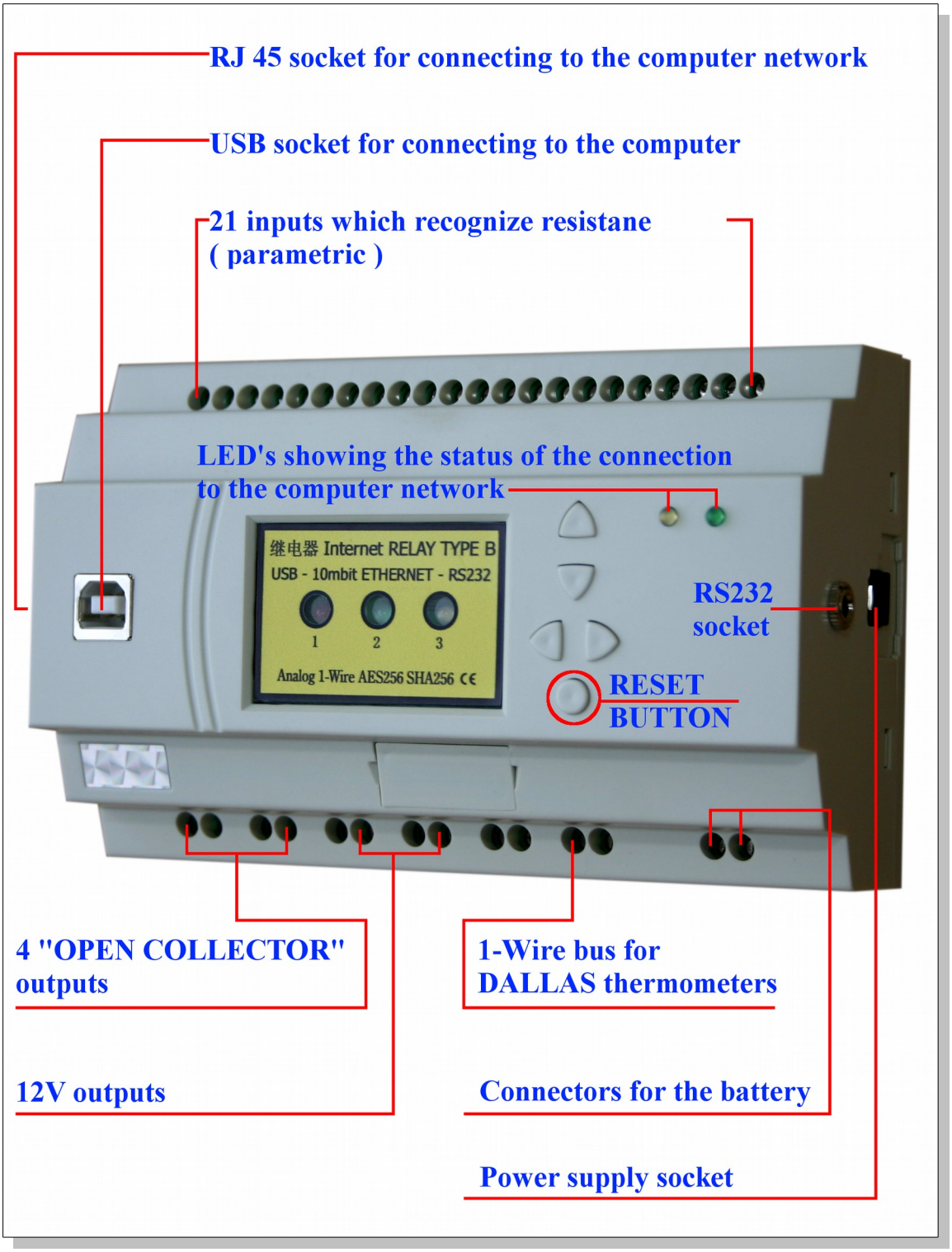
The password or digest are not processed at all during the transmission. The device receives the packet and tries to decrypt it using the digest in it's memory. If the decryption is unsuccessful, the device will not reply to the packet at all. It will not find data identifying the sender, the time stamp will be incorrect, the data will be encrypted using a different key etc.

The way the data is encrypted is transparent and it's safety is not based on secret algorithms. It's based mainly on the length of the password and whether or not you keep the password to ourself or lose it. If you have any doubts whether your password is still safe you can always change it through USB and using the PIN code, and reinstall the infected operating system.

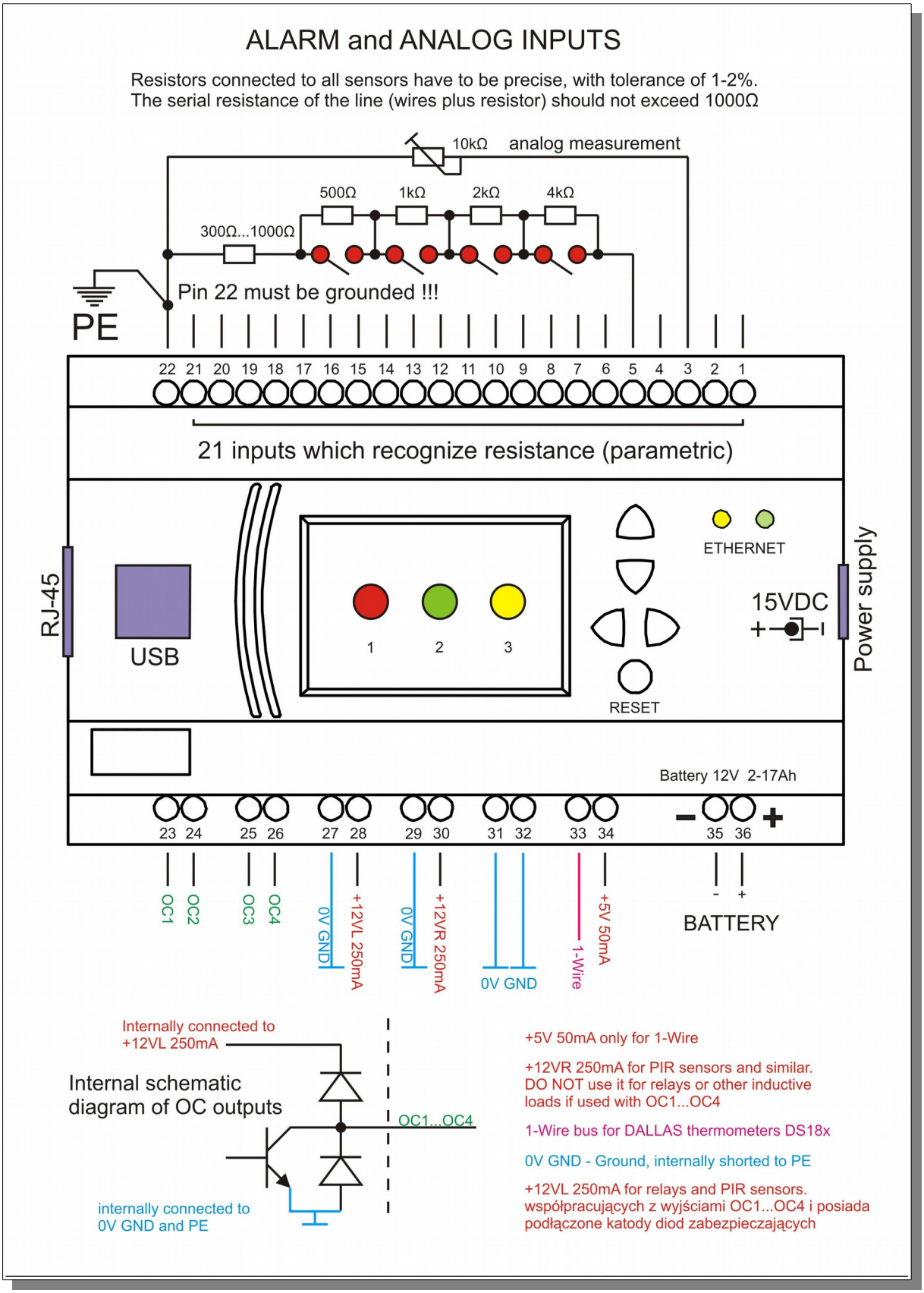
Used security technologies:

- Hash function SHA-256 - http://en.wikipedia.org/wiki/Sha256
- Symmetrical encryption with the AES-256 algorithm -http://en.wikipedia.org/wiki/Aes256
- Time stamping

2. BUILD


RJ 45 socket for connecting to the computer network
USB socket for connecting to the computer
21 inputs which recognize resistane
(parametric)
LED's showing the status of the connection
to the computer network
继电器 Internet RELAY TYPE B
USB - 10mbit ETHERNET - RS232
1
2
3
Analog 1-Wire AES256 SHA256
RS232
socket
RESET
BUTTON
4 "OPEN COLLECTOR"
outputs
1-Wire bus for
DALLAS thermometers
12V outputs
Connectors for the battery
Power supply socket

3. DEVICE DIAGRAM


ALARM and ANALOG INPUTS
Resistors connected to all sensors have to be precise, with tolerance of 1-2%.
The serial resistance of the line (wires plus resistor) should not exceed 1000Ω
10kΩ analog measurement
500Ω 1kΩ 2kΩ 4kΩ
300Ω...1000Ω
Pin 22 must be grounded !!!
PE
22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1
21 inputs which recognize resistance (parametric)
RJ-45
USB
1 2 3
RESET
ETHERNET
15VDC
Power supply
Battery 12V 2-17Ah
23 24 25 26 27 28 29 30 31 32 33 34 35 36
OC1 OC2 OC3 OC4 0V GND +12VL 250mA 0V GND +12VR 250mA 0V GND 1-Wire +5V 50mA - + BATTERY
Internally connected to +12VL 250mA
Internal schematic diagram of OC outputs
OC1...OC4
internally connected to 0V GND and PE
+5V 50mA only for 1-Wire
+12VR 250mA for PIR sensors and similar. DO NOT use it for relays or other inductive loads if used with OC1...OC4
1-Wire bus for DALLAS thermometers DS18x
0V GND - Ground, internally shorted to PE
+12VL 250mA for relays and PIR sensors. współpracujących z wyjściami OC1...OC4 i posiada podłączone katody diod zabezpieczających

4. CONNECTION DIAGRAMS

Below there is a link to a PDF file containing examples and connection diagrams useful when creating your own intelligent home installation and alarm system.

The file is systematically updated with new examples so you should check it regularly.

Guidebook – your own intelligent home installation.

5. TECHNICAL SPECIFICATION

Weight of the device	0,6kg
Weight of the whole package	0,7kg
Dimensions length/width/height [mm]	144/90/57
Mounting	DIN rail
Power supply	An external, stabilized 15V 1A power-supply unit. Plug with plus inside. The PSU must always generate 15V. Otherwise battery charging will be to weak or to heavy.
Electricity consumption	Between 1W (electronics only) and 2W
Battery	12V gel battery input with a charging system
	Maximum battery charging current – 100mA
	Use VRLA batteries in the range from 2Ah to 17Ah. 7Ah batteries recommended.
Inputs	21 alarm/analog inputs which recognize resistance
	Option to add 8 or 16 inputs using DS2408 modules connected to the 1-Wire bus
Outputs	4 open collector type outputs, 2 +12V power supply outputs
	Option to add 8 or 16 outputs using DS2408 modules connected to the 1-Wire bus
1-Wire	1-Wire bus with the ability to connect 32 DALLAS digital thermometers DS18B20, DS18S20 or DS1822 (+5V, DQ and GND)
	16 bulit-in thermostats with heating/cooling options
	8 built-in differential thermostats
Connectors	**RJ45 Ethernet interface 10 Mbit** used for remote communication
	USB 2.0 interface used for device configuration and time synchronization
	RS232 interface as TTL
Ethernet	10Mbit full duplex without polarity detection
	A surge protector for the LAN and for the power supply requires grounding!!! For grounding use pin 22.
Additionally	The Alarm's **complex programmable logic**
	A **multichannel, astronomical clock** that tracks sunrises and sunsets, and which may also cooperate with the built-in timer

	An independent **real-time clock** synchronized with Internet time via NTP
	Data encryption system AES 256
	Powerful yet easy to use **operating software**

6. ADDITIONALLY

6.1. Firmware

This device has an easy-to-use, user friendly f**irmware update function**. Frequent firmware updates will accommodate the device to the user's needs.

It is possible to implement additional functions accordingly to the client’s wishes.

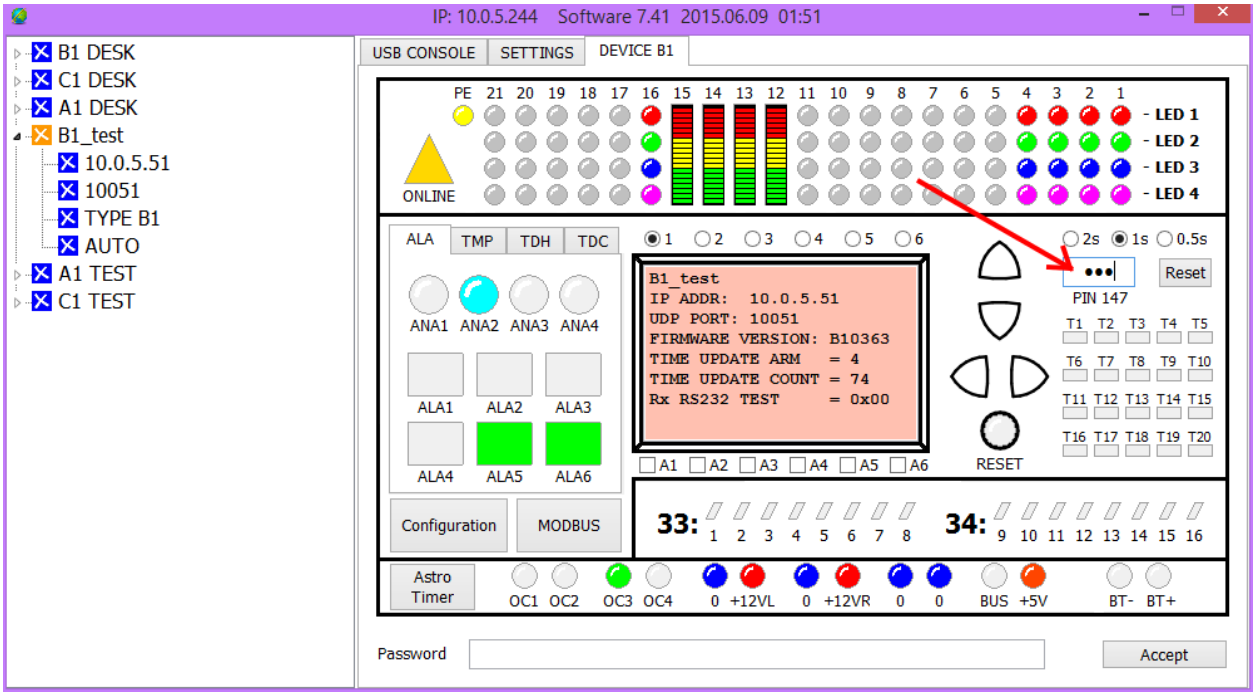
Firmware can be updated very conveniently through USB and any breaks in communication will not result in damage to the device. Firmware update is secured by a **long PIN code** so that no unauthorized persons can use this function. Every firmware is digitally signed which ensures that only the manufacturer's firmware will work in the device.

6.2. Interfaces

The device has all interfaces used for communication and no additional cords or adapters are required. Standard computer network wiring is enough for the device to work properly.

This type of functionality is not found in any other device available on the market.

6.3. Safety code



Code 147 – simply enter 147 into the field on the right of the main display in the software described as **PIN 147** . When you enter this code, the device will exit the 'safe mode'. This mode protects you from accidentally clicking on an input, the RESET button or a relay. It is a sort of a safety fuse. After you enter the number 147, the screen will change color into light pink and all the options in the program will be unlocked. Pressing the small 'RESET' button, placed next to the field where you enter the code, will put the device back into safe mode. In safe mode you can enter individual menus but you cannot click on strategic places on the screen.

Another PIN **code – 369** – also exists. It has a similar function as the one presented above but it also makes the device send out packets 10 times per second. This mode is for testing the bandwidth.

6.4. Programming and operation

This is not a typical programmable logic controller. You do not program it in the STL language or build a LAD ladder.

This is a programmable controller with an alarm and measuring functions, programmed by building logical functions using available variables, intended for people who do not have time to learn how to program relays but who need to carry out a quick modernization of their electrical installation, who want to equip it with additional logical functions, temporal dependencies between circuits but first and foremost who want to control the installation using the Internet without having to worry whether the transmission is safe.

Examples of use:

As an alarm system:

1. 21 resistance recognizing inputs (parametrized, parametric)
2. The ability to connect to up to 84 sensors such as reed switches in doors and windows, motion sensors, flooding sensors, photoresistors or fire detection sensors
3. Every sensor is recognized individually and has a name assigned by the user
4. The ability to program up to 6 alarm zones and 4 analog alarm zones
5. View of the sensor and alarm zone status via the internet using a PC or a mobile device (cell phone, tablet) with the Android operating system, up to 30 phones or tablets at the same time.

Circuit control

1. Gates, engines, lighting
2. 4 open collector outputs
3. 2 +12V charging outputs
4. The option to expand the amount of inputs/outputs by 8 or 16 using a 1-Wire module
5. View of the output and relay statuses via the Internet using a PC or a mobile device (cell phone, tablet) with the Android operating system. Up to 30 phones or tablets at the same time.

Temperature measurement and regulation

1. 1-Wire bus with the ability to connect 32 Dallas digital thermometers
2. View of the thermometer statuses via the Internet using a PC or a mobile device (cell phone, tablet) with the Android operating system. Up to 30 phones or tablets at the same time.
3. 16 built-in temperature regulators with cooling and heating functions, cooperating with the Dallas thermometers
4. 8 built-in differential temperature regulators

- programming, status viewing and operation via the Internet using a PC
- real-time data transmission
- status viewing and remote control via the Internet using a PC or a mobile device (cell phone, tablet) with the Android operating system. Up to 30 phones or tablets at the same time.
- AES-256/SHA -256 encrypted data transmission
- multichannel astronomical clock following sunrises and sunsets, additionally cooperating with a built-in timer
- independent real-time clock synchronized via the Internet using NTP
- Ethernet RJ45 10Mbit network interface for remote communication
- USB2.0 interface for device configuration, password change and time synchronization
- RS232 interface in TTL standard
- complex programmable logic of the alarm itself
- complex yet simple to use control software for PC and Android
- easy installation on a DIN rail
- easy to carry out and user friendly firmware update function. Frequent firmware updates will adapt the device to the user's needs

This is not a typical PLC controller. This is a PLC optimized to work as an alarm and measuring unit.

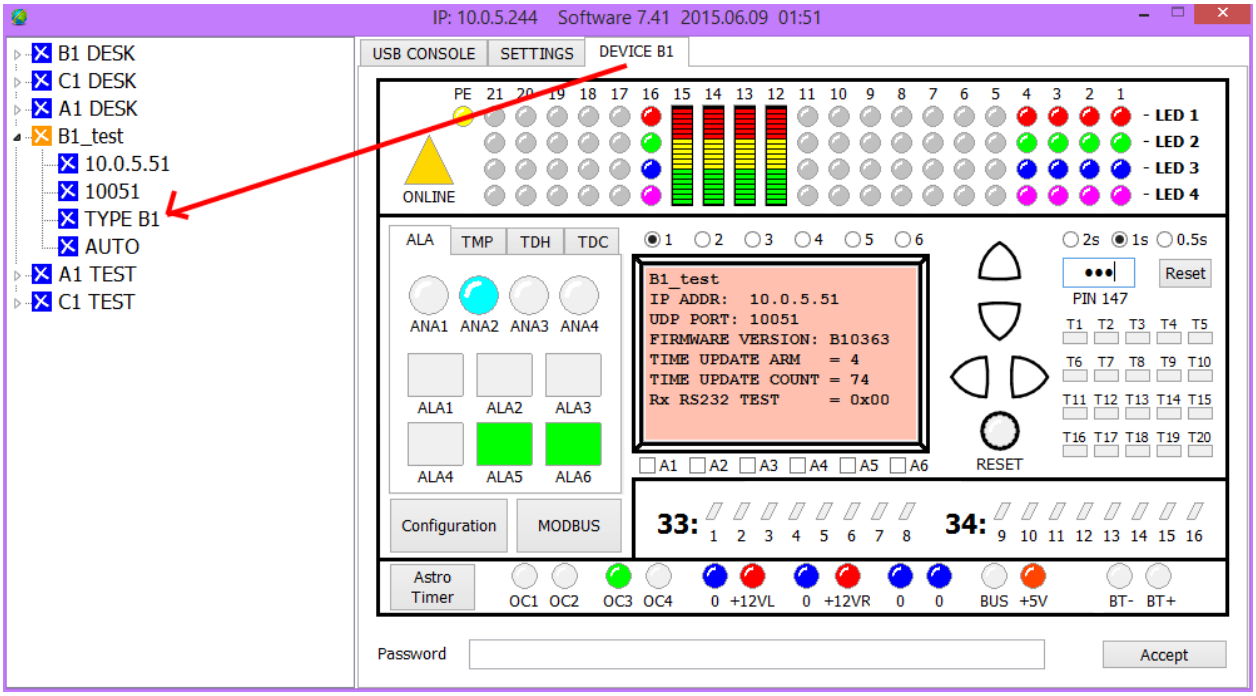
It is not programmed in a STL language or with a LAD ladder. This is a controller programmed by **building logical functions using available variables**, intended for people who do not have time to learn how to program relays but who need to carry out a quick modernization of their electrical installation, who want to equip it with additional logical functions, temporal dependencies between circuits but first and foremost who want to control the installation using the Internet without having to worry whether the transmission is safe.

6.5. PC software

The operating software is the same for the Programmable Alarm PLC2011B1, Programmable Relay PLC2011A1 and the Programmable Multicontroller PLC2011C1.

When adding a new device to the list you should choose whether it should be:

- TYPE A1 Relay PLC2011A1
- TYPE B1 Programmable Alarm PLC2011B1
- TYPE C1 Multicontroller PLC2011C1



Depending on which type was chosen, either the DEVICE A1, the DEVICE B1 or the DEVICE C1 tab will be activated in the main window.

“AUTO” timezone means that the device is in the same timezone as the computer you are using to operate it. If you are in a different timezone, you should choose the devices timezones taking into account current summer/winter time settings. This setting should show the current time in the location where the device is placed.

7. CONTENTS OF THE PACKAGE

1. PLC alarm unit in the form of a module mounted on a DIN rail
2. USB cable for connecting the device to a computer
3. stabilized, impulse 15VDC Power Supply Unit
4. CD with drivers, the user's manual and basic version of the software
5. a set of resistors : 4kΩ, 2kΩ, 1kΩ, 0.5kΩ and resistors in the range from 300Ω to 470Ω to up the resistance of the cords
6. calibration resistor 7.5k

8. SAFETY MEASURES

- **Before unpacking** you should check whether or not the package has been damaged during transport
- **After unpacking** you should check whether or not the device is mechanically damaged in a visible way. Do not start the device if you have any doubts. In this case contact the seller.
- **Before starting the device** you should read the manual, especially the part regarding safety.

ATTENTION!!!

The device should be installed and wired up only by a qualified electrician.

ATTENTION!!!

The device can only be used with triple-wire electrical installations with a separate PE ground wire. Connector #22 (the first one from the top, on the left side of the device) must be connected to a working Protective Earth/Ground wire. You cannot connect the neutral N wire or leave the connector unused.

ATTENTION!!!

Connection to mains electricity must be done accordingly to the manufacturer's instructions and applying safety measures.

Use only the power supply unit provided by the manufacturer together with the device.

The electrical outlet to which you plan on connecting the device, should itself be connected to a switchgear equipped with appropriate fuses and circuit-breakers (RCDs) to ensure that the user is safe from being electrocuted.

The electrical installation should be done by licensed personnel and in accordance with safety standards and applying norms.

The manufacturer and distributor are not responsible for any injuries to a third-party or damage done to objects as a result of not following the instructions above.

9. FIRST RUN

In short:

1. You configure the network addresses and set up the password through an USB cable
2. You synchronize time through an USB cable

The first run can **only be carried out using an USB cable**.
You cannot do it through the local computer network. It is a safety measure so that the password cannot be changed remotely. You can only change the password if you connect with the device directly using an USB cable.

To run the device for the first time you also need the **PIN code**.

This code is placed on the cover of the CD containing drivers.

This code must not be lost! Without it you will not be able to re-acquire control over the relay if you lose or forget your password.

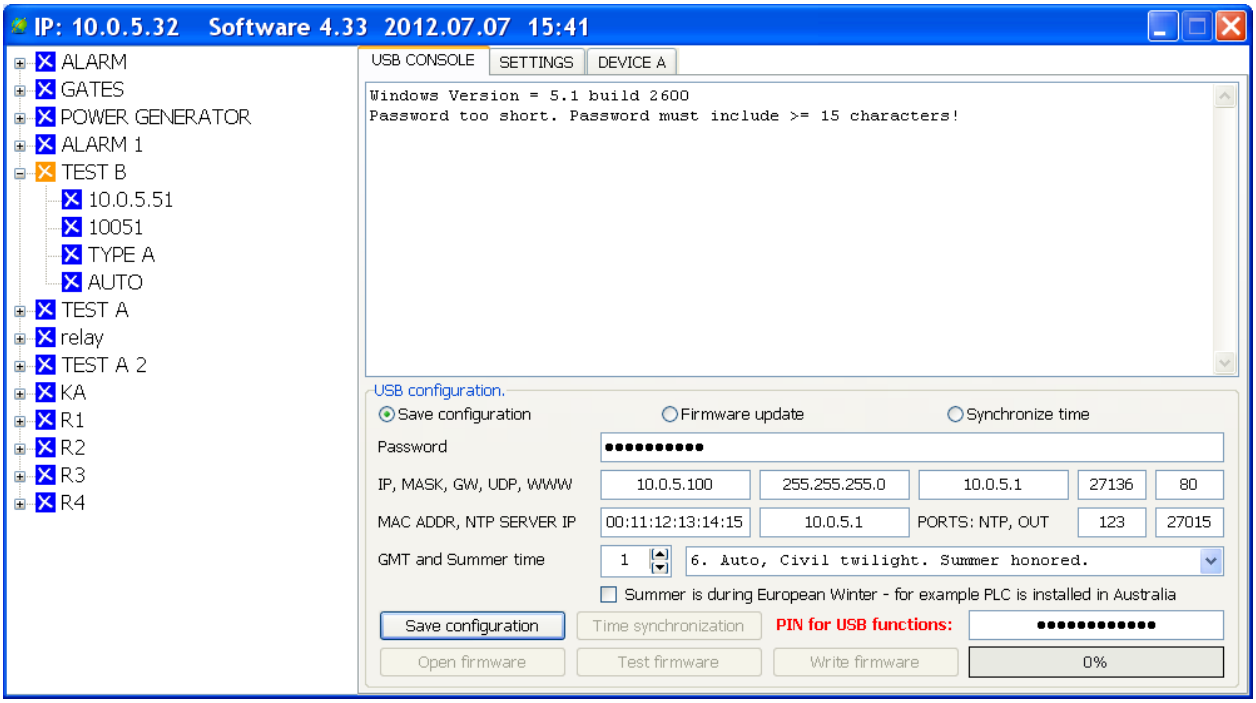
The purpose of the first run is to set the device's:

1. Network addresses
2. TCP/IP protocol port numbers
3. Time zone
4. Password

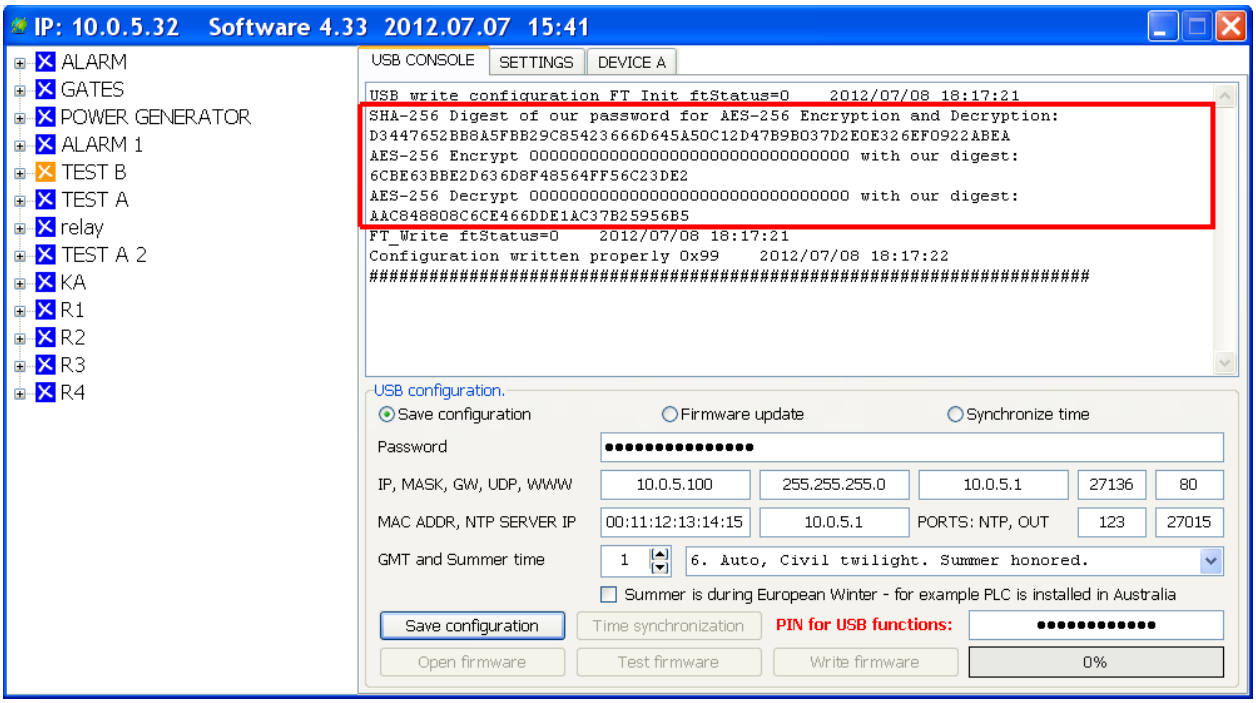
9.1. Password and SALT

The password must have at least 15 characters to be sure that device is immune to hacker attempts at guessing or breaking the password. In buildings of heavy importance the recommended password length is over 24 characters. The software requires a password of at least 15 characters and will not save the configuration if the password is too short. On account of customer safety, there is no way to bypass this requirement.

If the password is too short then the following message will display in the console.



If the password is given correctly the message in the console will look like this:



The first part is a cryptographic hash (also called digest) generated using SHA-256 function.

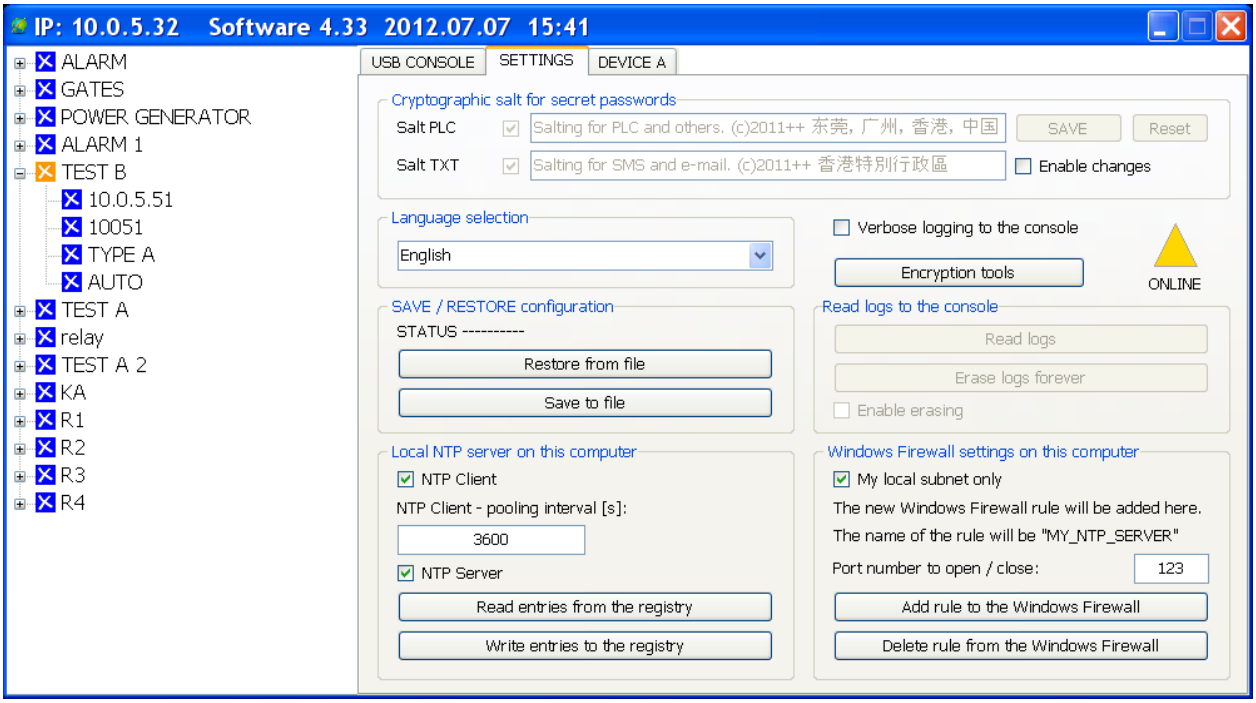
In our case the password is fifteen "1" (111111111111111) without SALT.

Hash for this password will always look the same:
D3447652BB8A5FBB29C85423666D645A50C12D47B9B037D2E0E326EF0922ABEA

Additionally, to make it even harder to break the password, that it is to guess it if the hash is revealed, you can turn on the SALT function.

Salt is data added to the password before hashing with the SHA-256 function. It's nothing more than a connection of the text of your password and another, non secret text.

To activate the SALT function we have to go to the SETTINGS tab first.



You have two options

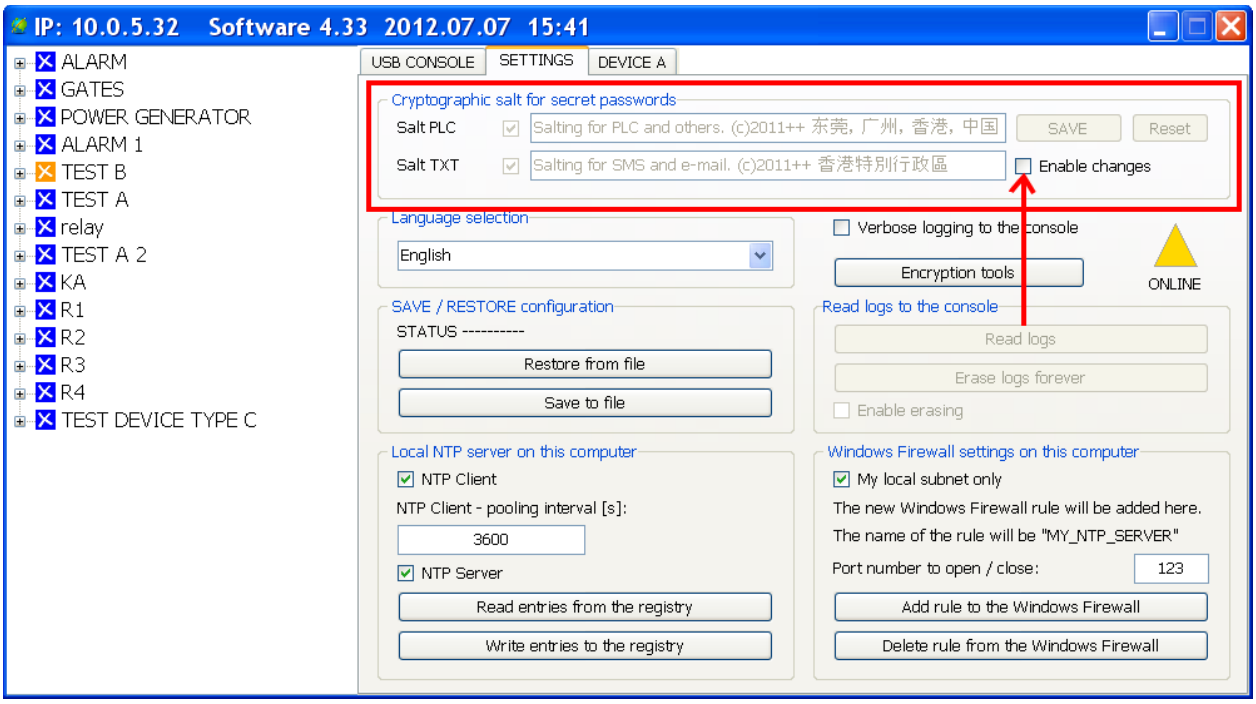
Salt PLC
Salt TXT

Only the first function is important when assigning a password.

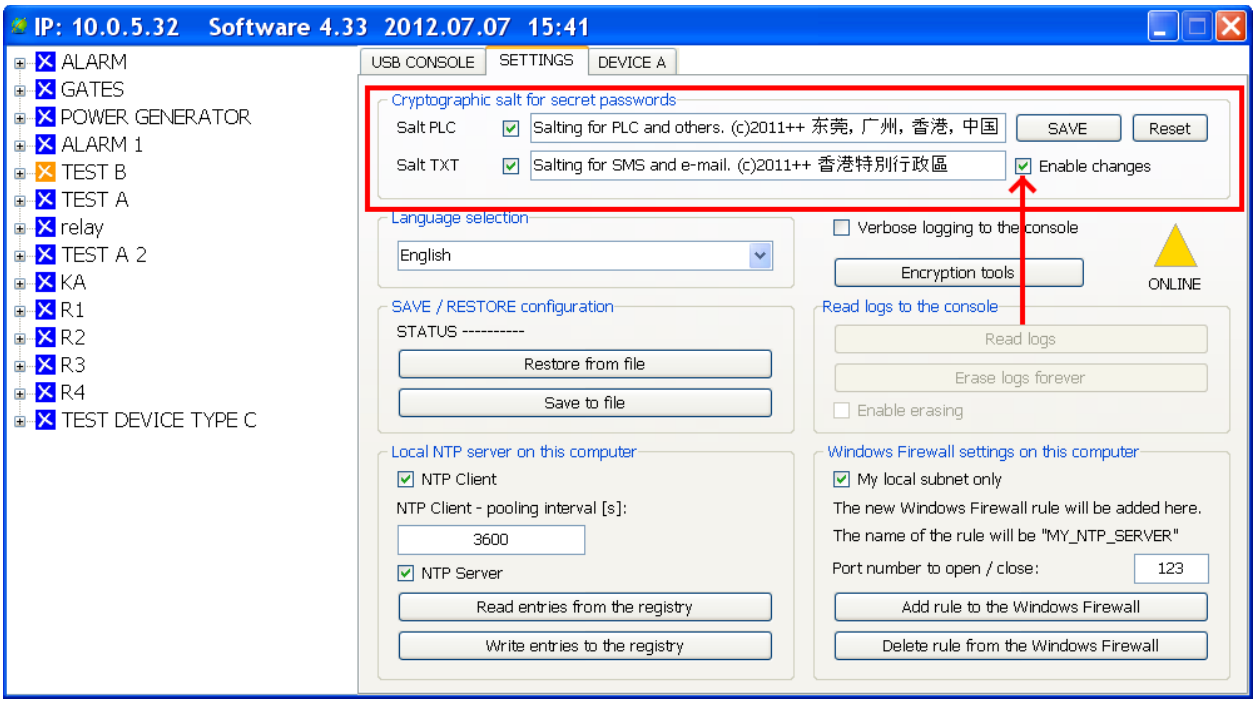
Both of the Salt functions are switched on by default and consist of a random string of characters. In the fields you can enter any Salt you want.

The Salt can consist of up to 64 characters. The characters should be entered randomly. It is also a good idea to use special characters such as letters written in different alphabets. The more complicated, the better. Both Salts must be different from each other. More about Salt for text messages is written in a latter part of the manual.

To make any changes to the default settings you must first check the **Enable changes** checkbox.



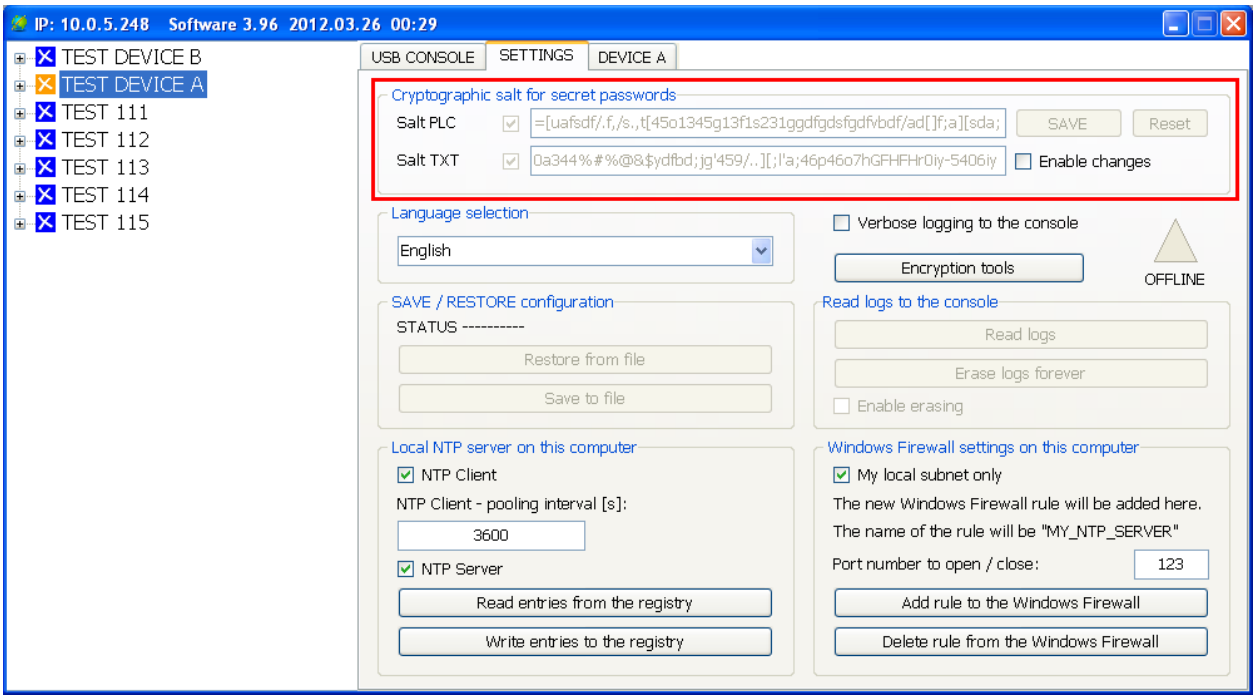
The ability to make changes will be unlocked.



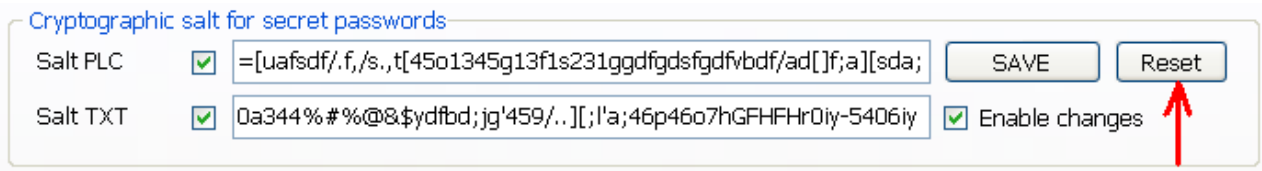
You will now be able to switch Salt on and off and enter your own Salt text.

Using two different Salts will give you two different encryption keys for the same password. When you send commands to your PLC device they will be encrypted in a different way than when you use the **Encryption tools** window for text messages.

After you save the changes with the **SAVE** button the ability to modify the settings will be blocked until you check the **Enable changes** checkbox again.



To return to default settings you need to press the **Reset** button while remembering to first check the **Enable changes** checkbox.



The settings will be changed to the default settings and the ability to make changes will be blocked until you check the **Enable changes** checkbox again.

The values entered in these fields are kept in an XML file in the folder with the software to control the PLC.

Below you have a comparison of a password hash for the same password (fifteen “ones”):

- without Salt

```
USB_write_configuration FT_Init ftStatus=0    2012/05/09 18:27:47
SHA-256 Digest of our password for AES-256 Encryption and Decryption:
D3447652BB8A5FBB29C85423666D645A50C12D47B9B037D2E0E326EF0922ABEA
AES-256 Encrypt 00000000000000000000000000000000 with our digest:
6CBE63BBE2D636D8F48564FF56C23DE2
AES-256 Decrypt 00000000000000000000000000000000 with our digest:
AAC848808C6CE466DDE1AC37B25956B5
FT_Write ftStatus=0    2012/05/09 18:27:47
Configuration written properly 0x99    2012/05/09 18:27:48
################################################################################
```

– with the default Salt

```
USB_write_configuration FT_Init ftStatus=0    2012/05/09 19:56:13
SHA-256 Digest of our password for AES-256 Encryption and Decryption:
F6D1F2A4FD07EBFC88C7FD286E2FB35DB4AA40AB82E49D1D5CBDF96876B00A9B
AES-256 Encrypt 00000000000000000000000000000000 with our digest:
737BBD085887D79A20B7A37A2535A655
AES-256 Decrypt 00000000000000000000000000000000 with our digest:
60A129435F9E38504F801E9042E01C50
FT_Write ftStatus=0    2012/05/09 19:56:13
Configuration written properly 0x99    2012/05/09 19:56:13
################################################################################
```

As you can see, both are completely different.

When assigning a password you need to pay attention whether Salt is on or not. If you assign a password with Salt switched on and then you switch the Salt option off, you will not be able to connect to your device because even though the password is seemingly the same, the hash is completely different for the salted and unsalted versions of the password.

A hash with or without salt is generated each time you enter the password and confirm it using the **Accept** button. If you pick from the list a device without salt or with a different salt, you need to enter the password again. The password is destroyed immediately after being confirmed and the software is operating solely with the mathematically processed hash of that password and with or without values from the Salt options.

It may happen that you will not be able to connect to the device without any apparent reason. You should then check the Salt settings, remind yourself what settings have you made in the software and how did you configure the device via USB. If the device password was set without Salt then you need to switch off the **Salt PLC** option, then save the settings and enter the password again.

Both the **Salt PLC** and **Salt TXT** options are switched on by default and use the default values to operate.

We advise to use even the default values.

ATTENTION!
Most failures in communication are connected to Salt settings, either in the software for PC or Android, or to errors made during configuration via USB. You should really pay attention to what you are doing. The SHA-256 hashes are visible so that you can see whether the password with salt gives out the same result as during the device configuration. If you have any problems with connecting to the device, you should first check the SALT settings. Try to remember whether Salt was on during configuration via USB, whether the Salt is now the same in both your PC and Android software.

After choosing the **Verbose logging to console** option, the SHA-256 hash with the inclusion of the SALT will be shown in the console, when trying to connect to the device after you enter and confirm the password. You should analyze this data and the settings that you have made.

9.2. Computer Network

The computer network parameters must be set accurately as otherwise there is no chance of connecting with the device. Remember to enter the IP address with the dots, do not enter other characters. You configure the device, entering network addresses and the password, 'blindly'. There is no possibility or any function of the device or software that will enable you to retrieve the password or set parameters if communication through the computer network is lost or you forget your passwords. In this case you need to use the PIN code and then reenter all the parameters. The values seen in the configuration window at the moment are only default values, an example of how the values should be entered, and you need to change them to your own values. Those values are not read from the device, they are entered by the software itself only as an example.

Every device should have a unique IP address and network interface MAC address, these two parameters are the minimum that should differ the devices from each other. Otherwise there will be conflicts in the local network. The computer you are planning to use for testing should belong to the same subnetwork as the device whose IP address you have entered (PLC Alarm).

First, we must set up our computer, at least for a while, to be sure that a connection is possible.

Network addresses in our computer should be set statically.
Our computer's IP address should be set to 10.0.5.2
Our subnet mask should be set to 255.255.255.0
Our gateway should be set to that of the router's – usually ends with '1' – 10.0.5.1
Save the network settings.

9.3. Entering the device into the configuration and password saving mode

1. Connect the power supply unit to the device.
2. Connect the device with your computer using an USB cable – the USB socket is on the left side of the front panel
3. Wait ca. 10 seconds
4. Press the round RESET button on the device's casing
5. Keep the RESET button pressed until all 3 LEDs turn on, then only the red will stay on, next the red LED will turn off and the yellow will turn on again. When the yellow LED turns on you need to release the RESET button. The green LED will turn and stay on.

All LEDs simultaneously

red LED

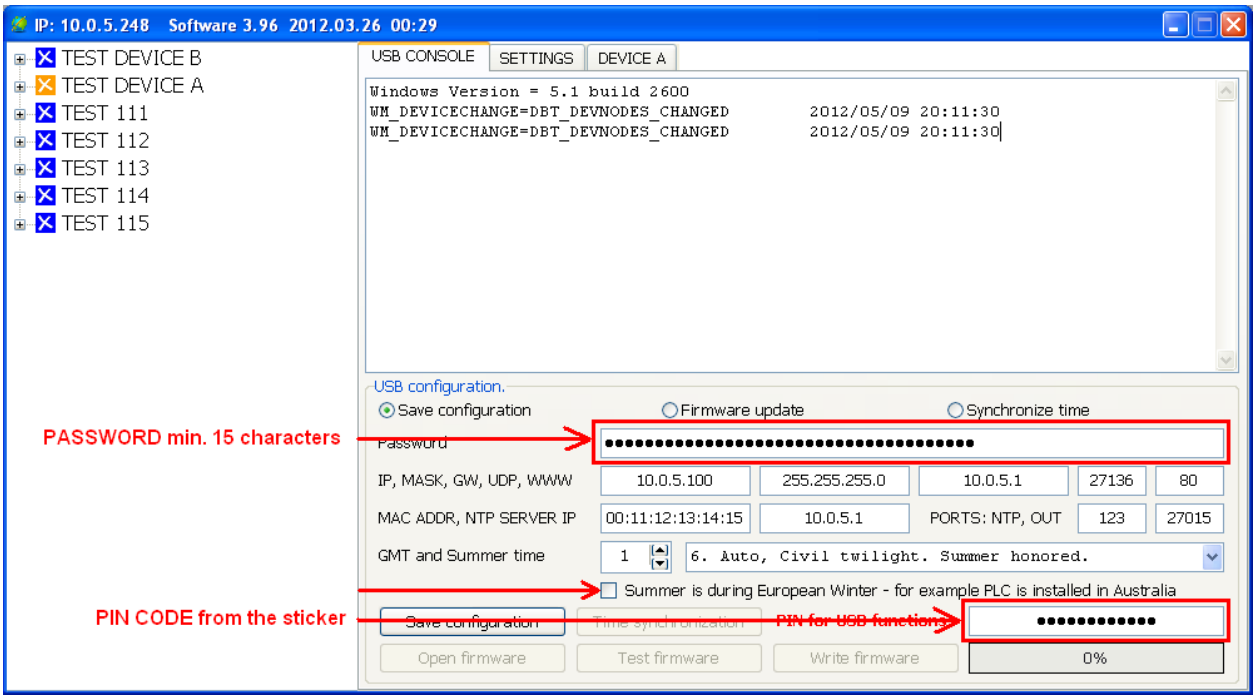
yellow LED (release RESET)

green LED stays on

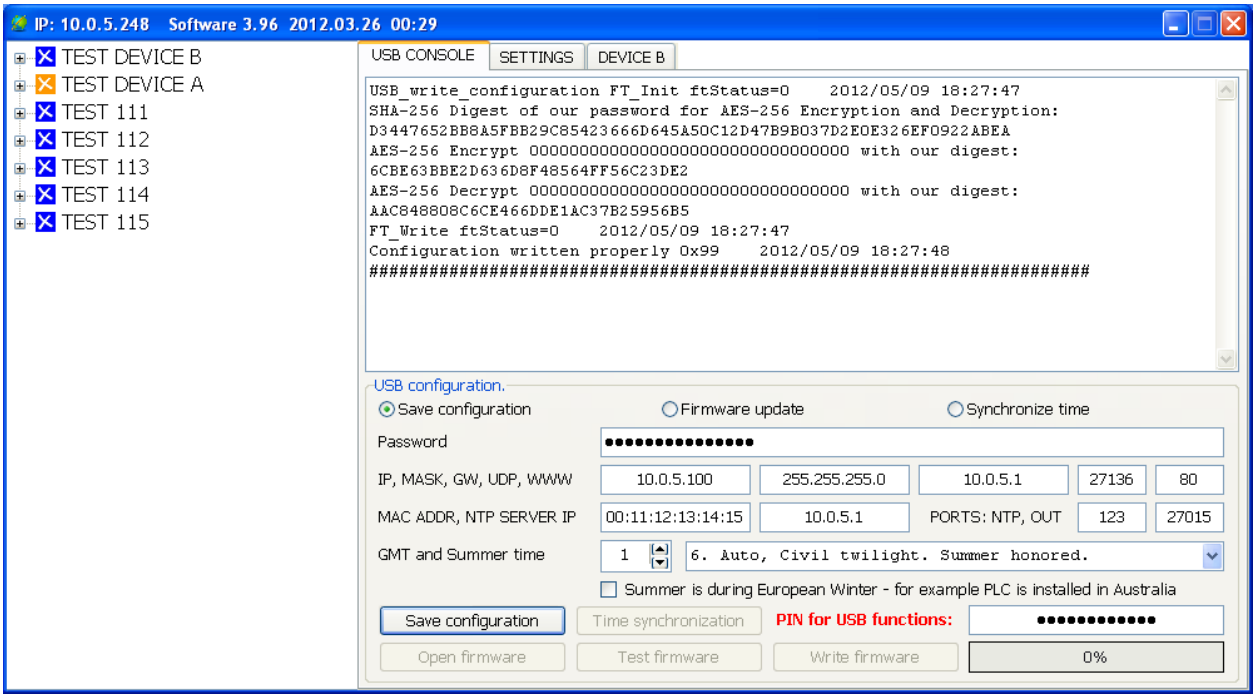
The device entered the new configuration and password saving mode or the firmware update mode. It is the same mode.

6. Keep the device in this mode with the green LED staying on
7. Run the software (on the CD in the package) on the computer
8. Enter the first tab ('USB CONSOLE') in the main window
9. In the 'USB configuration' field click the 'Save configuration' option button. Appropriate boxes will become highlighted.
10. Assuming the default values stay unaltered, you only need to enter the PIN code from the sticker on your CD cover, enter an at least 15 character password in the password text box, set the time zone and mark whether or not the device is placed in a location in which summer is during winter in Europe (southern hemisphere) e.g in Australia. The time zone is very important as you need the correct time to be able to connect to the device through the LAN. The PIN code text box is in the lower right corner. We remind you once more that a password shorter than 15 characters will not be accepted and configuration parameters will not be saved to the device.

11. **The failure of this operation is usually caused by entering a wrong PIN. For example, make sure that you have distinguished the number '1' from the letter 'l' or the number '0' from letter 'O'**



12. Press the configuration saving button – Save configuration
13. If the actions presented above are executed properly then in the text window you will see a message with the digest of your password. It is the proper password which will be used to encrypt the transmission. Do not save the digest. It is of no use to us and can help hackers. The digest is presented only to slake the user's curiosity during the first configuration and should not be saved anywhere.



14. After this action, communication will not yet be possible. On the left side of the program window you will see that your device has been added but you must synchronize time before communication between the device and the computer network is possible. If you enter different IP addresses you must also change the device's description in the device list on the left. Without a proper entry on the device list, you will not be able to connect with the device by LAN or the Internet.

15. After completing these actions press the RESET button and wait until the device reboots itself an enters it's normal work mode. From this moment the device's WWW website will be working and you can ping the device's IP address.

16. To see if this is true open your web browser and type in "http://10.0.5.100" or whatever other IP address you have given the device. Our devices web server response should show up.

17. You can also open menu START->Run and type in the command "ping -t 10.0.5.100" or other given IP address. Remember to type without the quotation marks.

18. **Communication using software will not yet be possible due to safety concerns** as the software allows you to deeply interfere with the device and switch the relays. **You still need to do a one-time time synchronization.**

19. Please watch the video manual and read the chapter about time synchronization.

The first run procedure is the same for the all PLC2011 devices.

10. TIME SYNCHRONIZATION

The purpose of time synchronization is to make the time in your device identical to the atomic time delivered to your computers or mobile devices. Without properly synchronizing the time it will be impossible to connect to the device. The difference in time cannot be bigger that +/- 15 seconds.

10.1. When do you need to synchronize the time using the USB cable?

1. After you run the device for the first time and save the password and network settings
2. Every time you unplug the main power supply and the battery, meaning after a total loss of power

10.2. Battery

A battery must be connected to the device at all times.

Without a battery you will need to connect the device with a computer using an USB cable and synchronize time every time there is a loss of power.

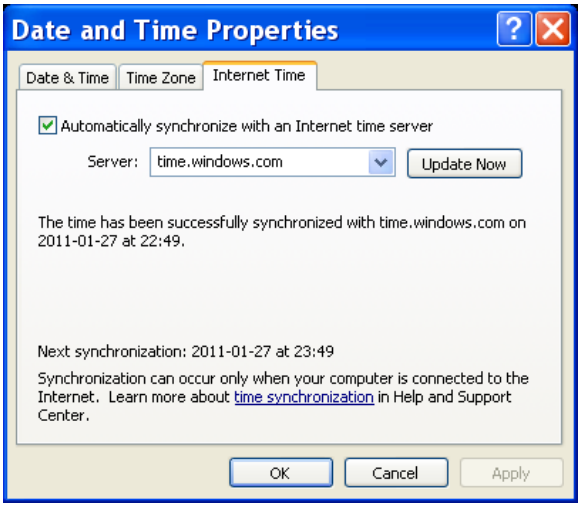
During a period of power outage, the device should work on a battery so that you can connect to the device via the computer network and remotely check the cause of the power loss. Therefor a battery should always be used. This allows us not to worry about connecting the device to a computer and synchronizing time every time there is a power outage. We recommend that you use a gel battery that has a capacity of up to 17Ah.

Without the time set correctly the features related to the Astronomical clock will malfunction or not function at all.

Admittedly, the device does have automatic synchronization and downloads the correct time from NTP server set by us but only within the range of the same minute. The year, month, day, hour, minute and day of the week must all match. After a loss of power the time and date will be calculated from zero so communication will be impossible.

10.3. Updating time in the computer

Before you update the time in your device, you first need to update the time in your computer. Some clocks in computer can be ahead or behind the actual time even ten-odd seconds. This is not a good occurrence. Synchronization of time in the device means you download the time from your computer to the device via an USB cable. This means you need to have the correct time set in your computer. In any Windows operation system updating time is easy. Just double-click on the clock in the lower right corner of your screen, at the end of the task bar. The 'Date and time properties' window will pop-out. In this window in the 'Internet time' tab you will find a button used to update the time.


Date and Time Properties
Date & Time
Time Zone
Internet Time
Automatically synchronize with an Internet time server
Server:
time.windows.com
Update Now
The time has been successfully synchronized with time.windows.com on 2011-01-27 at 22:49.
Next synchronization: 2011-01-27 at 23:49
Synchronization can occur only when your computer is connected to the Internet. Learn more about time synchronization in Help and Support Center.
OK
Cancel
Apply

It is essential that you do this operation before you synchronize your device's time with your computer's.

If the time in your computer differs more than 15 seconds from the time in your device, there will be no communication regardless of previous synchronization.

The device will make sure that the difference in time is no more than 1 second if you enter a working IP for a Internet time server. Computers usually synchronize their clock once a week, so after a couple of days you may discover that communication was lost with your computer being at fault. You can change the frequency at which your computer synchronizes it's time. Appropriate tools are found in the 'SETTINGS' window. So, you need to make Windows synchronize the time with an Internet time server. The device synchronizes it's time every two minutes (only odd minutes), around the 30th second of the minute.

It does not matter whether the computer and the device use the same time server, they can use different servers, after synchronization they will always have the same time with a difference of no more than 1 second.

Why all of this? Why is time synchronization so important?

If only not to give an intruder a chance to intercept the transmission while your arming or disarming the alarm and use the stolen data in the future. All the data is time stamped an is valid in the present, not an hour or even a minute later. In the same time, the ability to access the device from several computer at once is preserved. All this is for safety. Remember that a couple of users can be connected to the device at the same time. You can have small, mobile computers in your home or office, you can connect to the device from one place having your other computers connected simultaneously from different locations. Sent commands and data packets are invalid 15 second after being generated but usually are useless after only one second.

Synchronizing the time personally may be a bit of a hassle for the user but you are shedding comfort for the sake of safety. Without seeing the password when you type it in to your computer it is not possible to take over control of the device. And even then you can always go home, connect the device to your computer with an USB cable, type in the PIN code and set a new password. The password cannot be changed via the Internet so even if someone does steal your password, he will not be able to change it afterward. You always have the possibility to take away access to the device by changing the password.

Remember that if you lose the PIN code you received with the device, you will not be able to change the password ever again. Therefor this code should be kept safe. It has been generated automatically and the manufacturer does not posses a copy. The PIN code is written into the device permanently and cannot be changed. When entering the password, remember different letter sizes are recognized.

The PIN code is not needed for time synchronization.
The only thing you need is the password you have entered when you started the device for the first time. The PIN code is used for the first and any other configuration and firmware update.

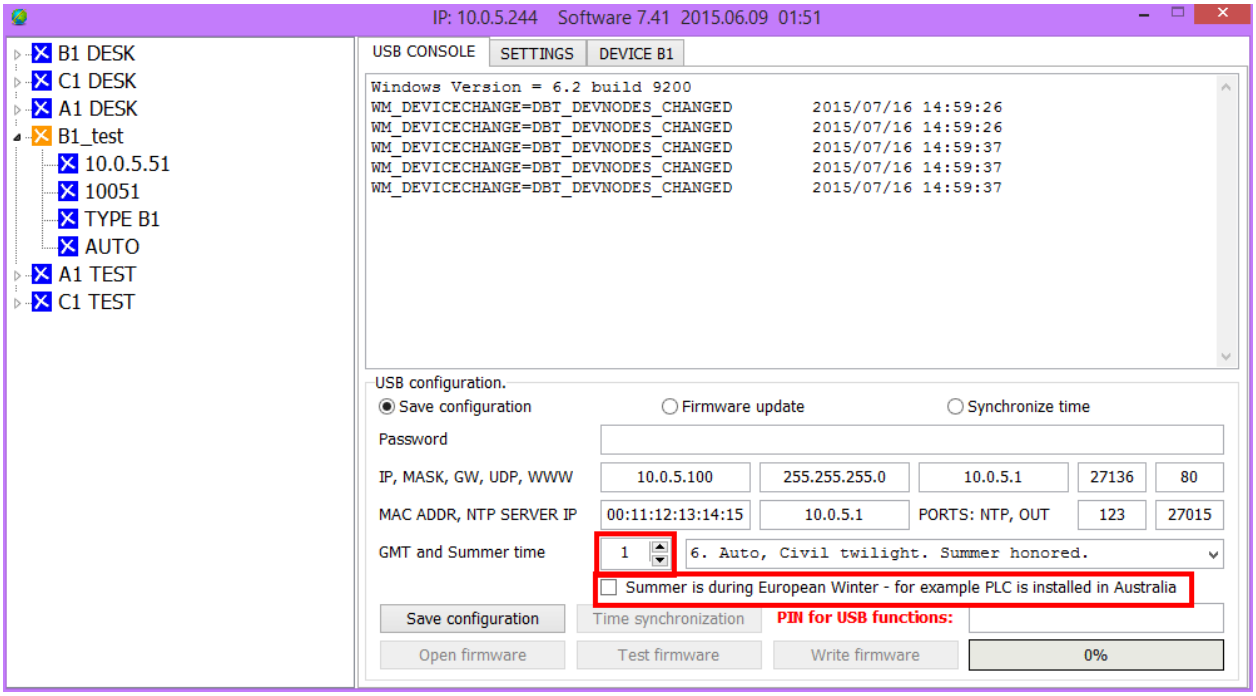
10.4. What to remember about when making time related settings

You need to ensure that the device always has the most up-to-date time as possible. Before synchronizing the time in the device with the time in your computer you must download the current time from an internet time server. You should not synchronize time if you entered the time in your computer manually. It is highly probable that when the computer finally downloads the time from a time server, the difference between the accurate time and what you entered manually and wrote into your device is so big that you will lose the ability to connect to the device. In this case you would need to synchronize the time again. However, if you download the accurate time from the internet from the beginning then you will avoid such problems.

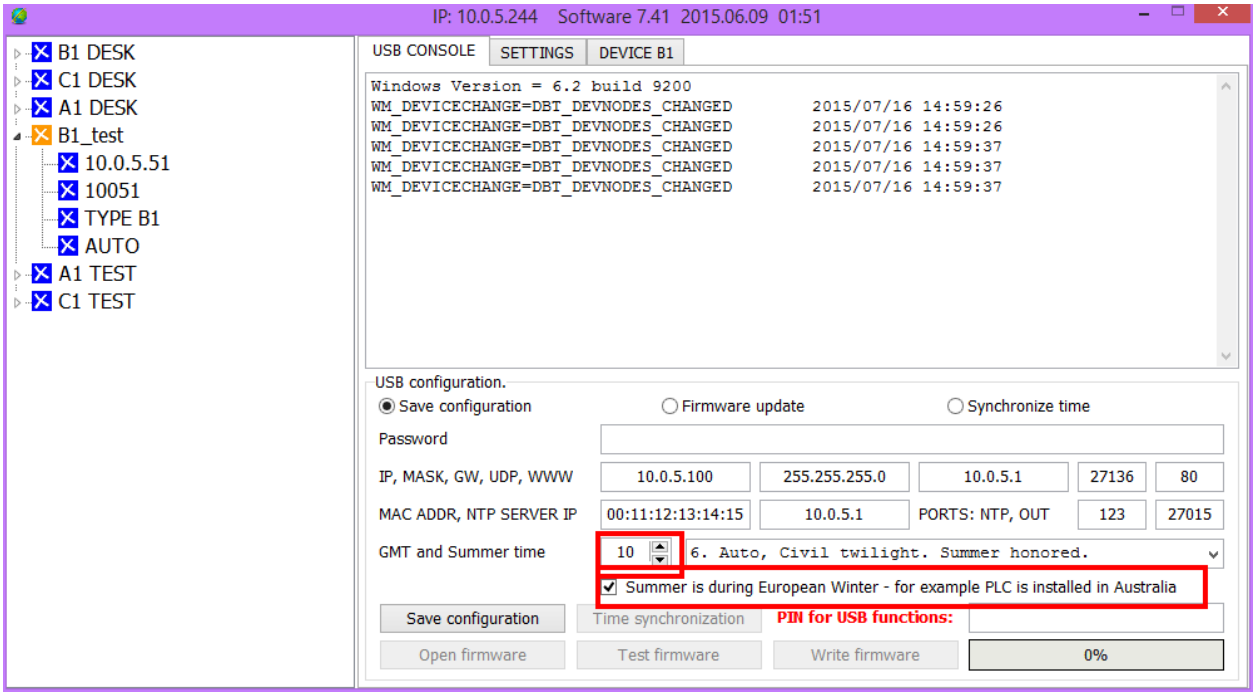
Remember to properly set the time zone where the device is mounted. For example, if the device is in a place where the time zone is GMT+10 but during synchronization you set the time zone to GMT+1 then the device will have problem with communication with the time server and will not update it's time. You do not change time zones when switching from winter to summer time or back. A properly configured device will take care of it itself. For example, if you place the device in Melbourne or Sydney then during the summer you should not change the time zone from GMT+10 to GMT+11, the software will do it for you automatically. Analogically, if you place it in Paris, Berlin or Rome then during the summer the time zone stays GMT+1, you do not change it to GMT+2.

If the device is placed in the southern hemisphere then remember to check the checkbox for the option that makes the device recognize this. Otherwise the device will not properly recognize it's time zone and time changes will be executed in an improper manner.

Example of settings for a device located in Paris

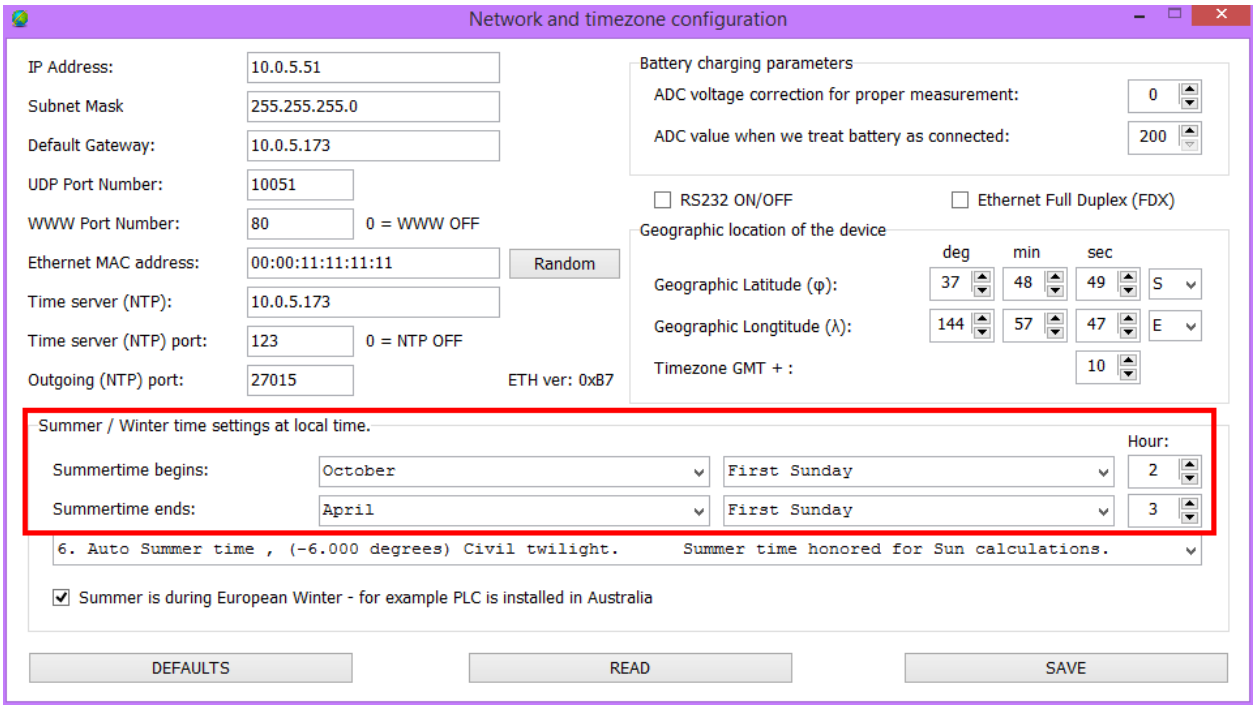


Example of settings for a device located in Melbourne

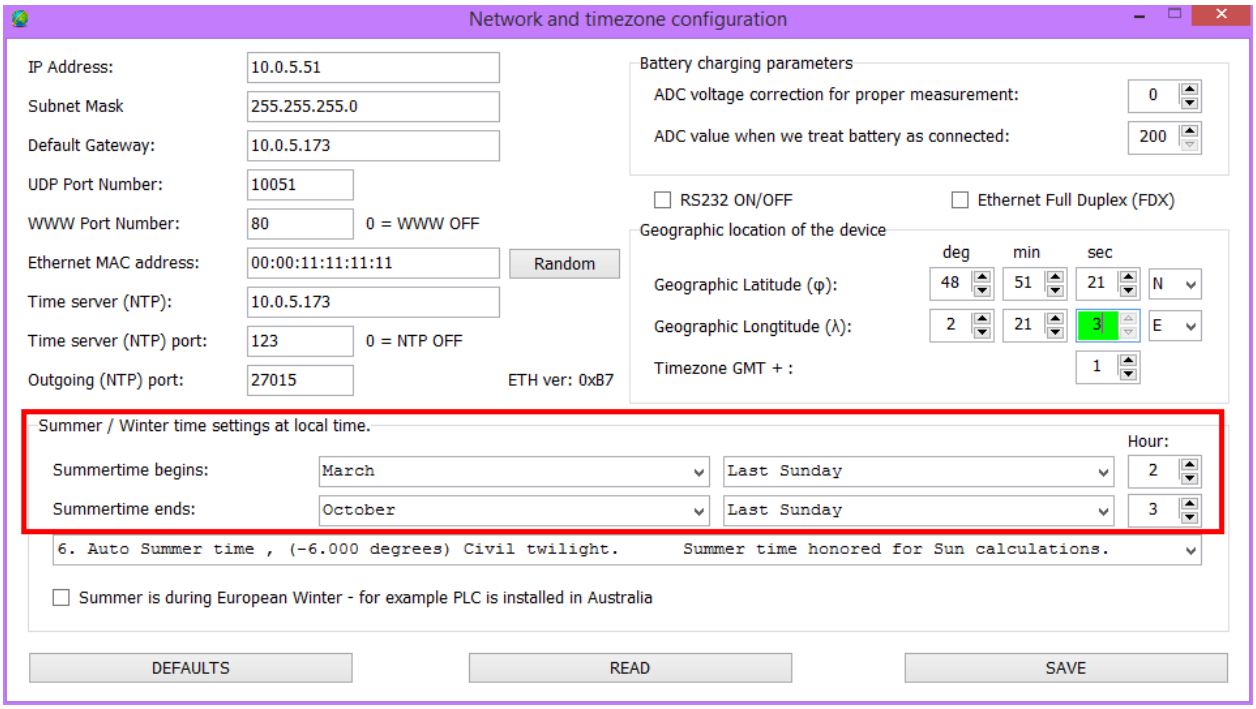


Remember to enter the rules concerning time changes in the location of the device. If you choose wrong months, days or hours of the time changes then in the moment when the time actually changes, either in the device or in your computer, connection with the device will be lost because the time will suddenly become incorrect.

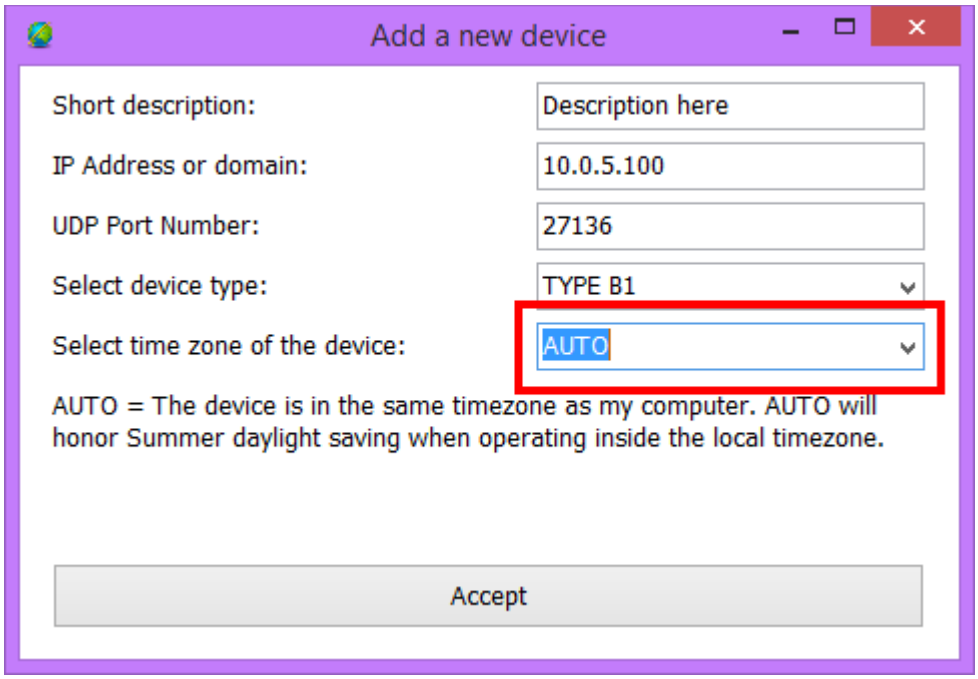
Example of settings for Melbourne (GMT+10)



Example of settings for Paris (GMT+1)

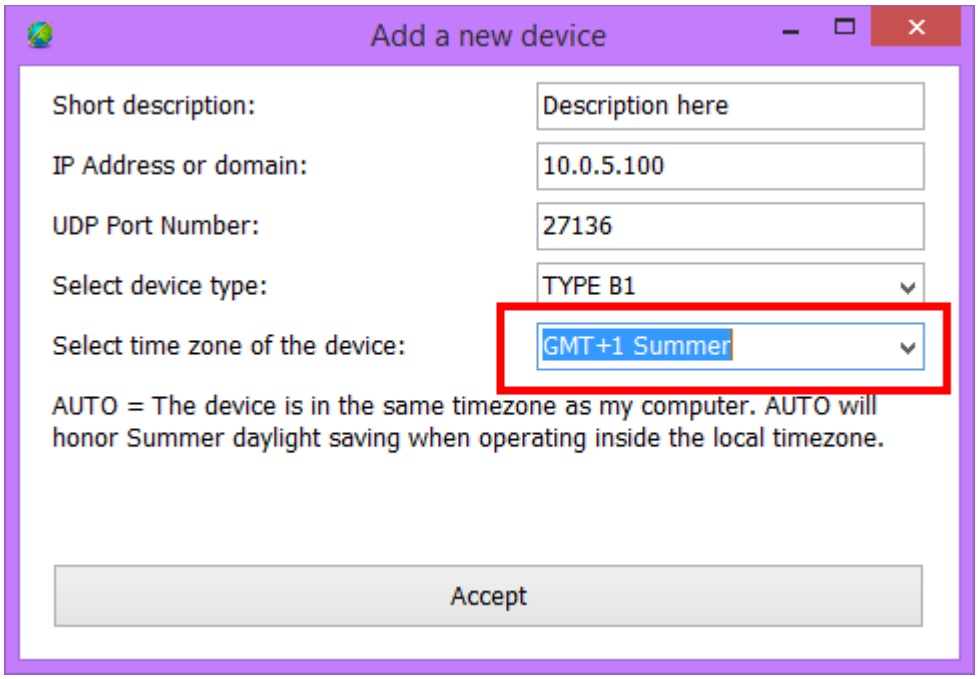


If you are in the same time zone as your device, then when adding a new device to the device list you set the time zone to AUTO. If you are sure that all settings, except the time settings, are correct then failure to connect while in AUTO mode means that there is definitely a problem with the time settings. You then need to revise all your steps to find the mistake that you have made.

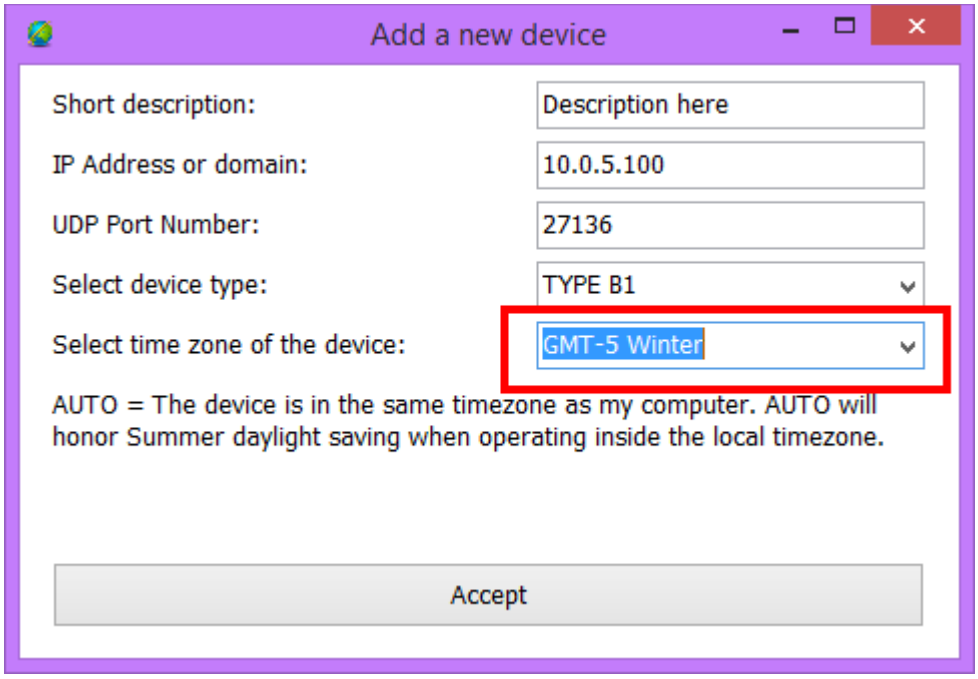

Add a new device
Short description:
Description here
IP Address or domain:
10.0.5.100
UDP Port Number:
27136
Select device type:
TYPE B1
Select time zone of the device:
AUTO
AUTO = The device is in the same timezone as my computer. AUTO will honor Summer daylight saving when operating inside the local timezone.
Accept

If you are in a different time zone than the device then you need to take that into account when adding a new device to the device list. Instead of setting AUTO you need to choose the timezone in the location where the device is placed including whether it currently has winter or summer time.

For instance, if in July you want to connect to a device in Hamburg while being in another part of the world, you need to enter GMT+1 Summer.


Add a new device
Short description:
Description here
IP Address or domain:
10.0.5.100
UDP Port Number:
27136
Select device type:
TYPE B1
Select time zone of the device:
GMT+1 Summer
AUTO = The device is in the same timezone as my computer. AUTO will honor Summer daylight saving when operating inside the local timezone.
Accept

If you want to connect to a device in New York in December, you need to enter GMT-5 Winter.

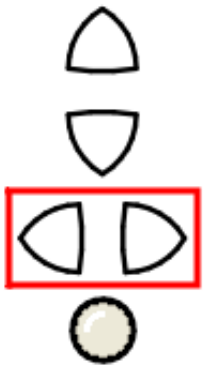

Add a new device
Short description:
Description here
IP Address or domain:
10.0.5.100
UDP Port Number:
27136
Select device type:
TYPE B1
Select time zone of the device:
GMT-5 Winter
AUTO = The device is in the same timezone as my computer. AUTO will honor Summer daylight saving when operating inside the local timezone.
Accept

You use the AUTO option only when being in the same timezone as the device.

10.5. How to synchronize time?

To synchronize time you need to enter the device into the **time synchronization mode.**

1. **Press and hold** the arrow button on the front panel (left “<-” or right “->”).



2. Holding the arrow button, press shortly the round RESET button (do not hold!) .

3. At first, all 3 LEDs will turn on and then off. Next the red LED will blink and then the yellow LED will turn and stay on.

4. Keep holding the arrow button until the yellow LED goes on.

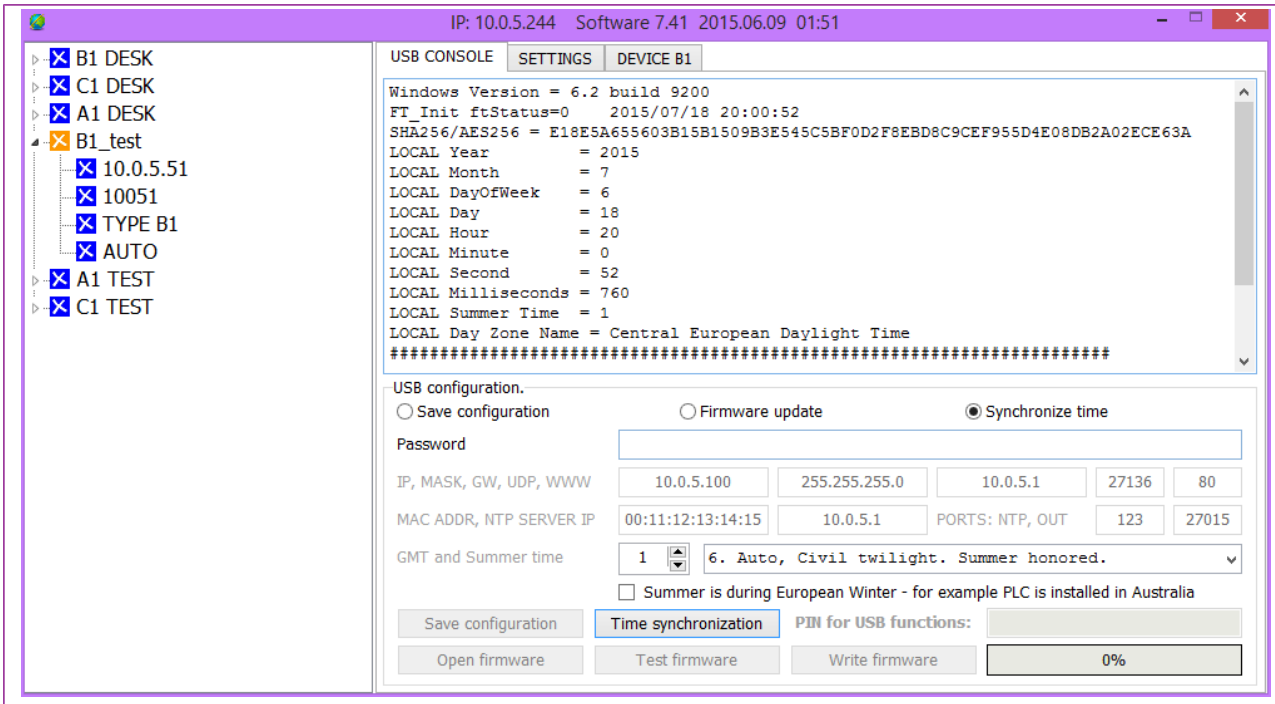
5. Release the arrow button.

6. The device is now in **time synchronization mode.**

7. In the 'USB console' tab click the **Synchronize time** round option button.

8. Boxes needed for this operation will become highlighted.

9. You need to set the timezone, enter your password and press the '**Time synchronization**' button. After a second you should get the message shown below and the device will reboot itself. If thb43e password entered is incorrect, the device will not reset and the red LED on the left will switch on. In this case you need to reenter the password correctly.



10. From this moment communication between the device and the computer should be working.

11. After synchronization you do not need to reenter the password when switching to the '**Device**' tab.

12. Sometimes you need to close and reopen the added device on the device list on the left. Double-click to collapse and the double-click again to expand. This should initiate the IP addresses again.

ATTENTION!!!

The main causes of failure in achieving connection between the device and a computer are wrong time, wrong timezone or inaccurate network parameters. As the timezone you should enter it's name e.g. Europe/Berlin, set AUTO for local time or enter as GMT+2, GMT+1, GMT etc. Entering the precise name of the timezone in which the relay is located (Europe/Berlin) gives you certainty that summer and winter time will be included automatically.

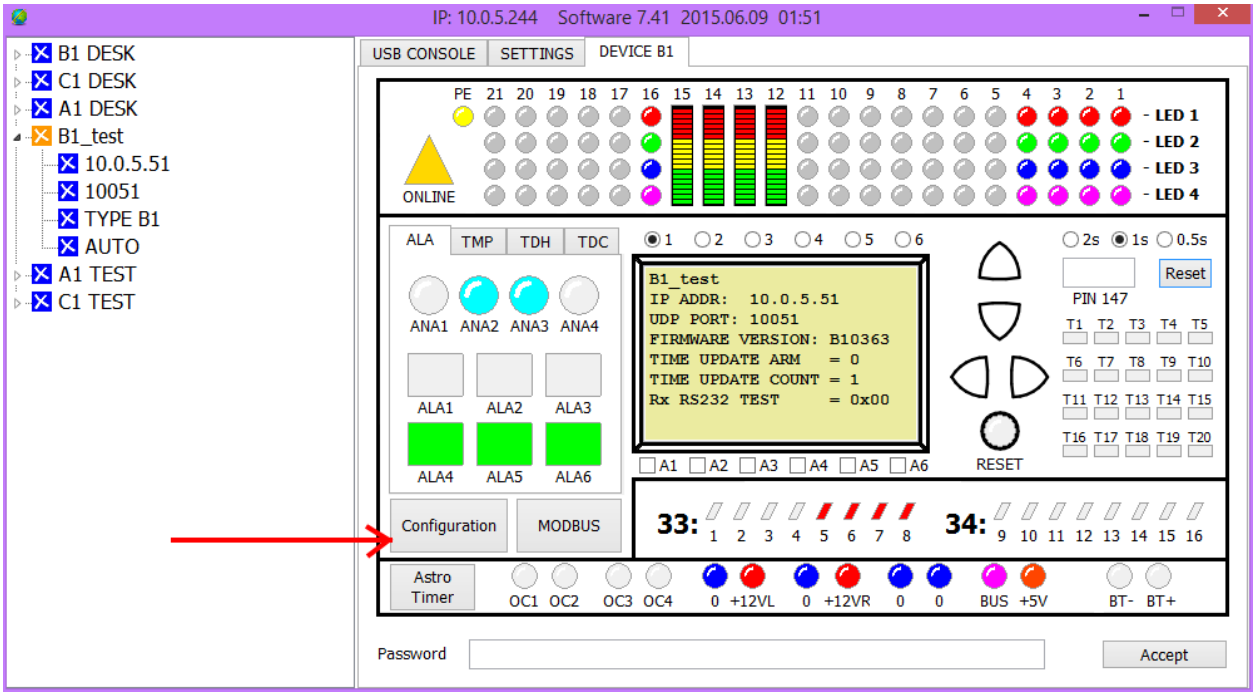
Your computer's local time and timezone are not important. You can be in any timezone you wish. The relay however is mounted in a certain timezone with certain rules regarding switching from summer to winter time and back. For instance, if you mount the relay in Moscow, the timezone should be 'Europe/Moscow'.

The time synchronization procedure is the same for the PLC2011B1 Alarm and both the Controllers - PLC2011A1 and PLC2011C1.

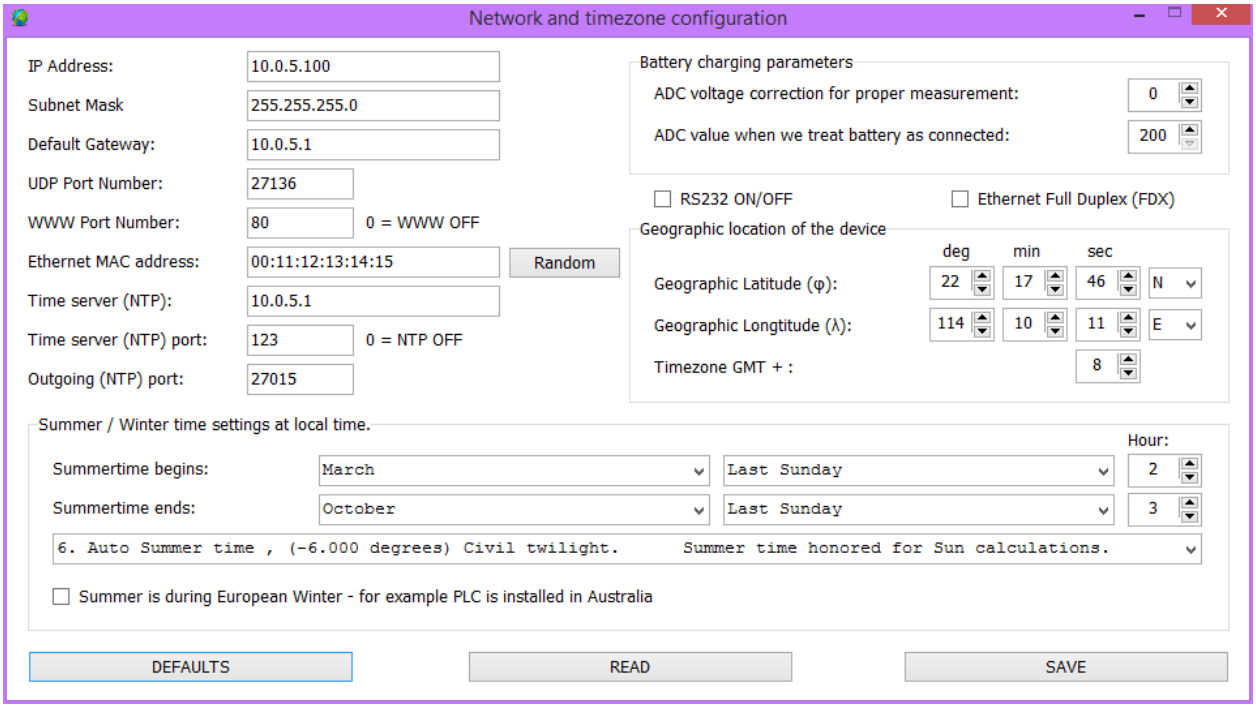
11. MAIN CONFIGURATION

The main configuration panel is designed to change the devices settings using the Internet, after you have successfully executed the 'First Run' procedure and synchronized time, meaning you should now be able to communicate with the device via the Internet. You will not be able to use this option without proper communication with the device.

To enter the main configuration panel press the **Configuration** button in the program's main screen. On the picture below this button is marked with a red arrow.



A window with the main configuration panel will pop out:


Network and timezone configuration
IP Address: 10.0.5.100
Subnet Mask 255.255.255.0
Default Gateway: 10.0.5.1
UDP Port Number: 27136
WWW Port Number: 80
0 = WWW OFF
Ethernet MAC address: 00:11:12:13:14:15
Random
Time server (NTP): 10.0.5.1
Time server (NTP) port: 123
0 = NTP OFF
Outgoing (NTP) port: 27015
Battery charging parameters
ADC voltage correction for proper measurement: 0
ADC value when we treat battery as connected: 200
RS232 ON/OFF
Ethernet Full Duplex (FDX)
Geographic location of the device
deg min sec
Geographic Latitude (φ): 22 17 46 N
Geographic Longtitude (λ): 114 10 11 E
Timezone GMT + : 8
Summer / Winter time settings at local time.
Hour:
Summertime begins: March Last Sunday 2
Summertime ends: October Last Sunday 3
6. Auto Summer time , (-6.000 degrees) Civil twilight. Summer time honored for Sun calculations.
Summer is during European Winter - for example PLC is installed in Australia
DEFAULTS
READ
SAVE

The following settings can be changed in this window:

1. All parameters of the computer network
2. The geographical coordinates of the device's localization
3. Set the time zone and the way of calculating the day of the switch from standard to summer time (DST) and back
4. Battery loading parameters
5. Switch RS232 on or off
6. Switch ethernet full duplex on or off. We recommend to switch off full duplex to reduce interference between the signals in the computer network cable if that cable is very long.
7. You cannot change the password. The password can only be changed when the device is connected to your computer via an USB cable and you enter the PIN code.

Be careful and know what you are doing when configuring the computer network. If you enter a wrong parameter you will not be able to communicate with the device. You will then have to connect the device to a computer with an USB cable and use the PIN code to execute the First Run procedure again.

You will not need to synchronize time again if the only thing wrong is the IP address.

If you keep the device at your house then configuring again using an USB cable will not be a big hassle, but if it's at your company or shop then you will lose precious time to get there and reconfigure the device. The transmission is secured using a couple of methods, including cryptographically, and there is no chance that the lack of communication is caused by the device. If a packet has even 1 bit corrupted is not possible to decrypt the packet, the whole packet will be recognized as invalid and rejected by the device.

The device configuration procedure in the Main Configuration window is the same for the PLC2011B1 Alarm and the PLC2011A1 and PLC2011C1 Controllers. The only exception is the TCP Port for WWW field where you leave '0' as the PLC2011B1 Alarm does not have a built-in www server.

11.1. Network configuration

An example of how the network can be configured is shown on the next diagram.

Presented network addresses are just the exemplary settings. Your real addresses and router configuration should be provided to you by your network administrator.

The device must have an invariable static IP address or otherwise you will not be able to connect to the device from outside the local network or even in the local network. Your every device must have a static IP known to you if you want to communicate with it.

It is also good to have a public, static IP address visible from the Internet. If that is a problem, you can also use DDNS services (dynamic domain name system). Router configuration is up to the network administrator. Every router is different and therefor you should read it's manual or ask the administrator.

Network configuration example below

IP: 10.0.5.100 – every device in a local network must have a unique IP address. There cannot be two identical IP addresses in a LAN segment.

MASK: 255.255.255.0 – The subnet mask is the same for every device in a Local Area Network.

GW: 10.0.5.1 – The default gateway is the router's LAN interface IP address. The router's address depends on the settings done by the network administrator. A router can be a dedicated device or one of the computer in the network.

NTP: 10.0.5.1 – An NTP server (time server) can be any computer, or even the router, if it has a time server function. It can be any computer on the Internet, your network or even your own computer.

MAC: 00:11:12:13:14:15 – The MAC address must be unique in the whole Local Network Area. It's the physical address of the Network Interface Controller in the device. There cannot be two identical MAC addresses in one LAN segment.

WWW PORT: 80 – In the PLC2011B0 device the WWW server does not exist. Ignore these settings as they do not have any effect.

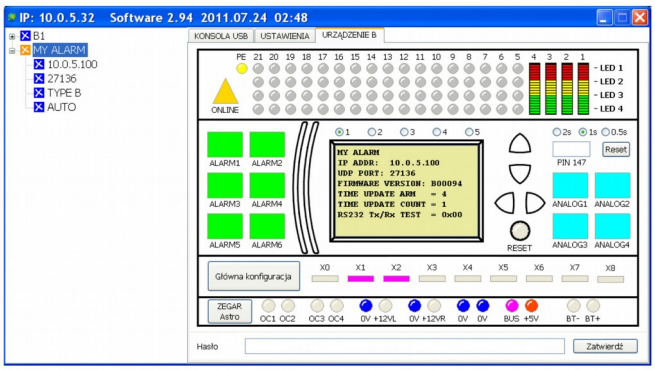
UDP PORT: 27136 - The UDP port at which the device listens. It can be set to any number in the range from 1 to 65535.

NTP PORT: 123 – UDP port that the device connects to. It is usually the time server port and you should expect the time server will use this port.

OUT PORT: 27015 - Local exit port for the UDP packets. When the device sends a message to the NTP server, it sets this number as the source's port and awaits a response at this port. It can be set to any number in the range from 1 to 65535.

STATIC IP – The router assigns IP addresses statically. This means the device will not acquire a new network address each time it is connecting to the network but you must set a permanent IP address. An example of how to set addresses of devices inside a network is shown in the diagram.

myrouter.dyndns.org
12.34.56.78



INTERNET

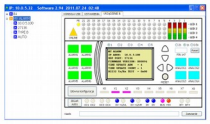
```
ROUTER PORT FORWARDING
Protocol    Ext Port    Int IP
UDP         27136       10.0.5.100
TCP         81          10.0.5.101
UDP         27137       10.0.5.101

ROUTER ACCESS LIST
MAC: 00:11:12:13:14:15
MAC: 00:11:12:13:14:16
```

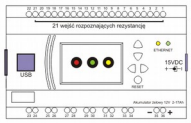
NTP SERVER
UDP PORT 123

10.0.5.1

```
IP:   10.0.5.100
MASK: 255.255.255.0
GW:   10.0.5.1
NTP:  10.0.5.1
MAC: 00:11:12:13:14:15
UDP PORT: 27136
NTP PORT: 123
OUT PORT: 27015
STATIC IP
```



ETHERNET LAN



```
IP:   10.0.5.5
MASK: 255.255.255.0
GW:   10.0.5.1
STATIC IP or DHCP
```

```
IP:   10.0.5.4
MASK: 255.255.255.0
GW:   10.0.5.1
STATIC IP or DHCP
```

```
IP:   10.0.5.3
MASK: 255.255.255.0
GW:   10.0.5.1
STATIC IP or DHCP
```

```
IP:   10.0.5.2
MASK: 255.255.255.0
GW:   10.0.5.1
STATIC IP or DHCP
```

```
IP:   10.0.5.101
MASK: 255.255.255.0
GW:   10.0.5.1
NTP:  10.0.5.1
MAC: 00:11:12:13:14:16
WWW PORT: 81
UDP PORT: 27137
NTP PORT: 123
OUT PORT: 27016
STATIC IP
```

11.2. What is a NTP server?

A NTP server is also called a time server.

It is used to give us the current time. It synchronizes itself to another computer in the Internet or an atomic time standard.

It's very important for communication with the devices that your computer has the actual current time, differing no more than 15 seconds from the time in your device. Computers used to control the device should have their times synchronized with an Internet time standard. If the time in your computer and the time in your device differ by more than 15 seconds, the communication between them will be lost.

This does not mean however that the communication has been lost for good. Communication will be regained if you synchronize your computer's time to an Internet or your own time server.

If you use several alarms, you should not set the same time server for every one of them. This time server will be flooded by packets coming from several devices, looking as if they all came from one source. This may cause the NTP server administrator to refuse you access to his server. This regards public NTP servers available on the internet.

In this case you can use a local device, like your router, to be the NTP server for your devices. The router would then synchronize it's time with an external NTP server and your relays would synchronize their time to the router without flooding an external NTP server. Your own time server would be able to handle a lot of your devices without creating too much traffic on an external server that does not belong to you but allows you access. You can also use a different NTP server for each of your devices.

NTP server addresses can be found using Internet search engines. There are lots of these servers and you should pick the ones close to your location.

The safest method is to set one of the computers in your local network or your router as the NTP server. The computer will not have to work all the time. It should be on every 2-3 days so that the relays can download the current time.

If the NTP server is not switched on continuously then it may happen sporadically that a command sent to the relay will not be executed. This occurs because when checking the communication with the NTP server, the device also checks communication with the local network. The relay the executes a short network settings initiation procedure which may cause loss of a command that was supposed to get to the relay at that moment. This is a way of protection against freezing. The relay must send out a question and receive an answer from the NTP server. If there is no response, data packets will be removed and network settings will be initiated again. The relay logic processes are not disrupted.

You need to make sure the computer frequently synchronizes time with the Internet. This is the safest method as it eliminates the risk of using a fake time server or someone manipulating with the time server. Any computer with any Windows system can be a time server. In some systems the time server option is turned off by default. You can switch it on using the tools in the 'SETTINGS' tab. Also, unblock port 123 in the Windows Firewall. For your laptop to become your time server you need to start the server service, set your laptop's update time to 3600s and unblock a port in the firewall. If you are using your laptop in your office even for only five minutes it will be enough for the relays to update the time.

It is good to have a continuously working router with a time server.

11.3. Geographical location of the device

In the devices location fields enter the geographical coordinates of the place where the device is mounted. They are required for the Astro timer to work correctly. The Astro timer uses this data to calculate the sun's position based on the location on Earth. You must also set your time zone in relation to the universal time (UT, UTC, GMT).

The next field contains options regarding automatic changes from standard time to summer time and back. For example, summer time starts on the last Sunday of March at 2:00 (A.M.) and ends on the last Sunday of October at 3:00 (A.M.). You can set these settings adequately for your region and in following years the time changes will be made automatically.

In this field there is one more important box. The options here are:

1. Winter time (+0h), (-0.833°), astronomic twilight
2. Summer time (+1h), (-0.833°), astronomic twilight
3. Winter time (+0h), (-6.000°), civil twilight
4. Summer time (+1h), (-6.000°), civil twilight
5. Auto Summer time, (-0.833°), Summer time honored for Sun calculations
6. Auto Summer time, (-6.000°), Summer time honored for Sun calculations [RECOMMENDED]
7. Auto Summer time, (-0.833°), Summer time disabled for Sun calculations
8. Auto Summer time, (-6.000°), Summer time disabled for Sun calculations

- Picking fields 1 to 4 will mean that you have to set winter and summer time manually. On the day that the time is changed you need to connect to the device and change it's time accordingly.

  After changing the time, the connection between the computer and the device will be lost as there will now be an hour of time difference. After you change your computer's time, the connection should be restored.

- Picking fields 5 to 8 will mean that the time change will be done automatically on the dates set above.

Astronomic twilight – the center of the Sun is -0.833° below the horizon. The Sun is not visible however the sky is still pretty bright. This is the time between sunset and dusk and between dawn and sunrise.

Civil twilight – the center of the Sun is -6° below the horizon. The Sun has not been visible for a long time now. At dusk it is almost completely dark. At dawn it is starting to get bright.

"**Summer time honored"** – an hour will be added to the astronomical time during summer. The Astro timer is also corrected by an hour during summer.

"**Summer time disabled"** – during summer the astronomical time will not be changed and an hour will not be added to sunset/sunrise calculations

This does not influence the three additional 'break' time periods that you can set individually for every day of the week (timer). These periods of time are always based on the current local time that changes from winter time to summer time and back. An hour will not be added to sunrise and sunset times, they will always stay in winter time – in relation to bars 1 and 2 in the **Astro timer**.

The default setting, appropriate for most users, is setting 6. In this setting everything is automatic. Twilight is set to civil, during summer an hour is added to the astronomical time.

At the bottom there is the **Summer is during European Winter** check-box. Tick it only if your device is actually in a place where summer is during European winter (southern hemisphere) such as Australia.

11.4. 12V battery charging parameters

In the upper right corner there are two parameters – **ADC voltage correction for proper measurement** and **ADC value when we treat battery as connected**.

Remember that what type of battery (what capacity or if it is used or brand new) you use is only your decision. Therefore you have the ability to calibrate the parameters.

The current voltage on the battery clamps can be seen on the screen on the main window after you click the '3' option button. Other useful and interesting data will also be shown. If the voltage value is not equal to the value measured using a universal meter then you can make calibrations by adding or subtracting the value you feel is appropriate in the **ADC voltage correction for proper measurement** box. You need to save the settings for them to take effect and results to be visible. If the results are not satisfactory, correct the settings until they are.

The second parameter is the moment when the battery is treated as connected. A brand new, properly functioning battery does not consume power when it is fully charged. The battery is charged to a voltage of about 13.5V and then flow of electricity stops almost completely.

The **ADC value when we treat battery as connected** parameter gives you the ability to correct the detection voltage drop of the connected battery. If the battery is detected, two 'lamps' in the software's main window will switch on. In the software, these 'lamps' are placed where the battery connectors are in the actual device. If the set value of this parameter is too low, the 'lamps' will switch off near the end of the charging period.

The following steps should be taken:

1. First, correct voltage readings with regard to the universal meter. 1 ADC unit corresponds to around 0.01V.
2. Next, read the ADC value from the software with the battery disconnected.
3. Enter this value into the **ADC value when we treat battery as connected** field and subtract +/- 10 units by clicking the down arrow.
4. Save the parameters and check whether they are working correctly. Check whether the 'lamps' switch off when the battery is disconnected.

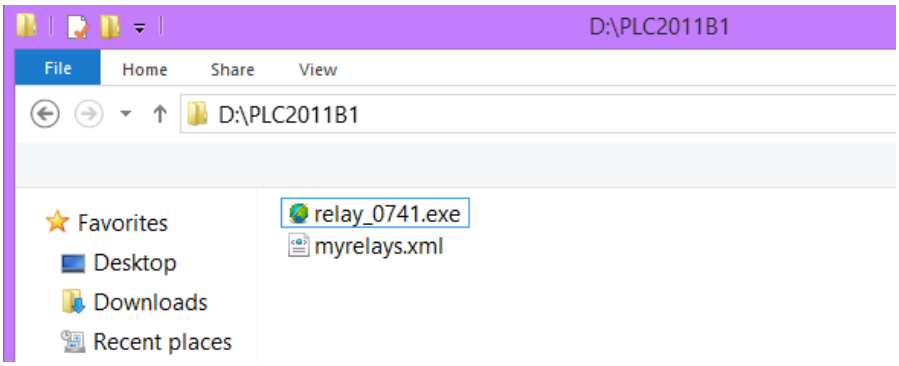
12. STARTING WORK WITH THE PROGRAM

The basic version of the software is delivered with the device.

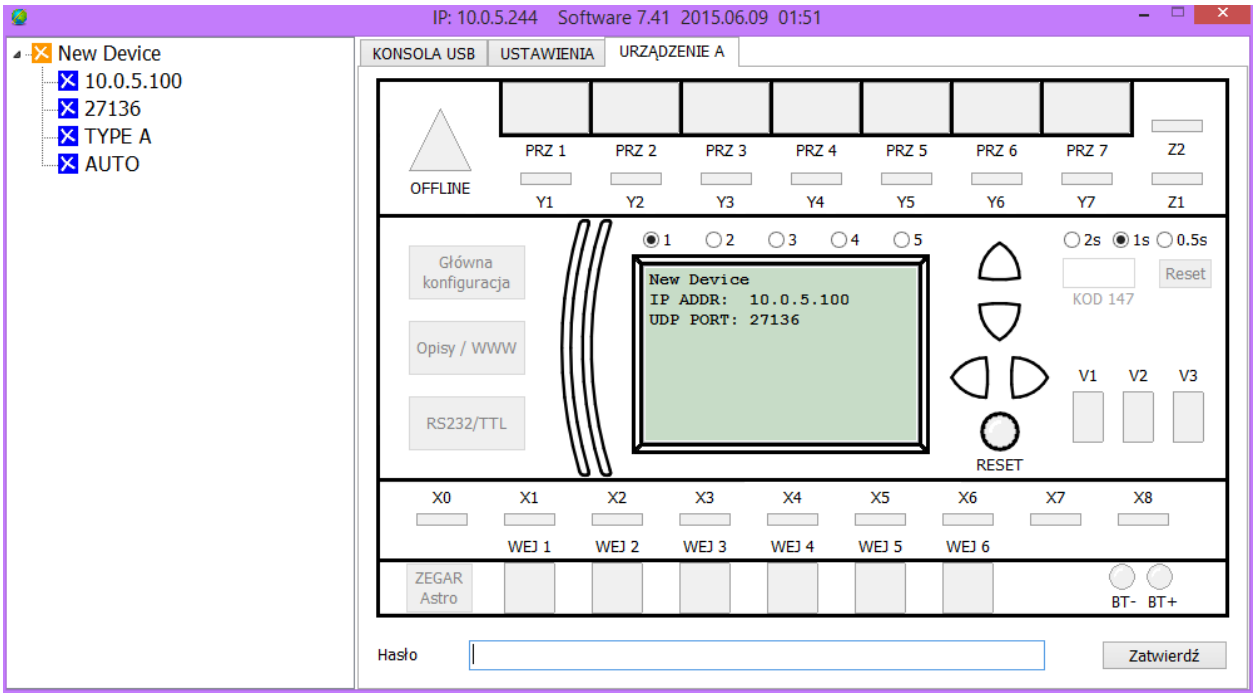
The program does not require installation. Simply copy it to a chosen location on your hard drive, could be a folder created earlier for this purpose, and run it.

When you run the program, a new file, “myrelays.xml”, will appear in the folder.

This is a configuration file which keeps inside sensor, alarm or button descriptions etc. If you plan on moving the program to another folder or running it on another computer remember to move the “myrelays.xml” file also as otherwise you will have to add new devices, assign names etc. again.



This is what the program looks like when you run it for the first time.

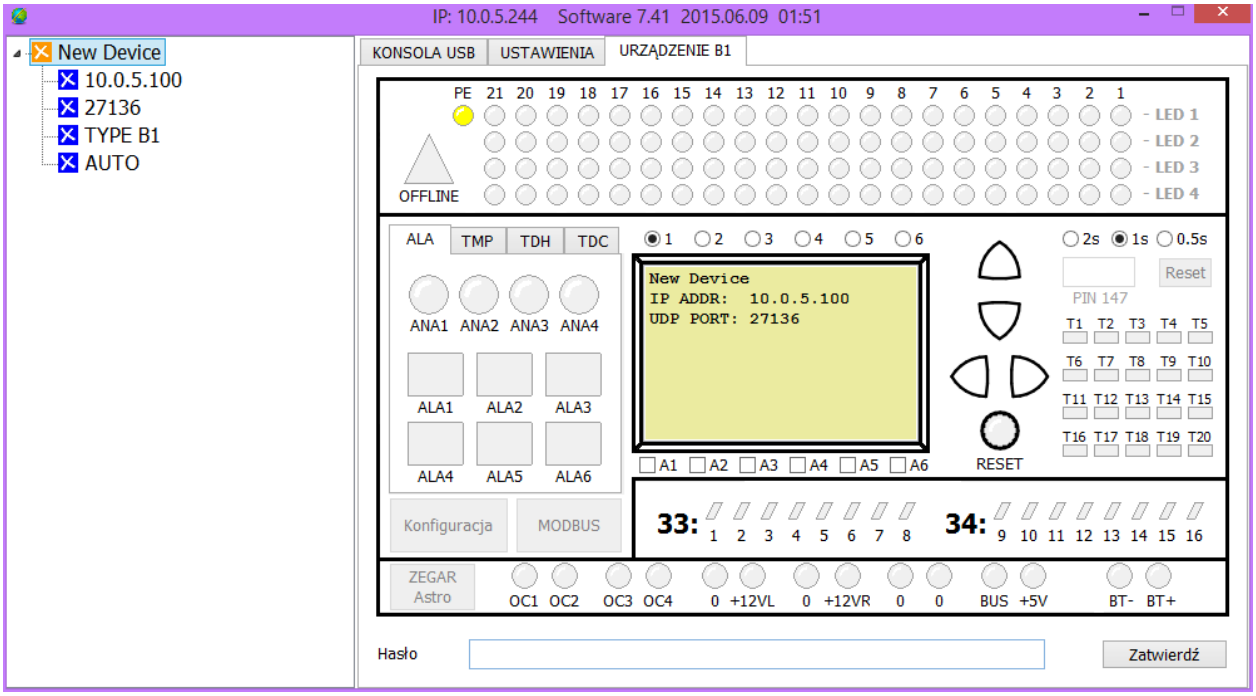


On the list on the left you should enter the data of the device to which you want to connect. Of course, the device should be configured earlier.
Device configuration is described in chapters 9-11.

Click on **New Device**.

It will become highlighted in blue. Now you can enter there any name that you had chosen for the given device.
Beneath enter the devices IP address, UDP port number and device type. In this case this will be TYPE B1.
The last position on the list is choosing the timezone in which the device is placed. If it is in the same timezone as your computer then pick AUTO.

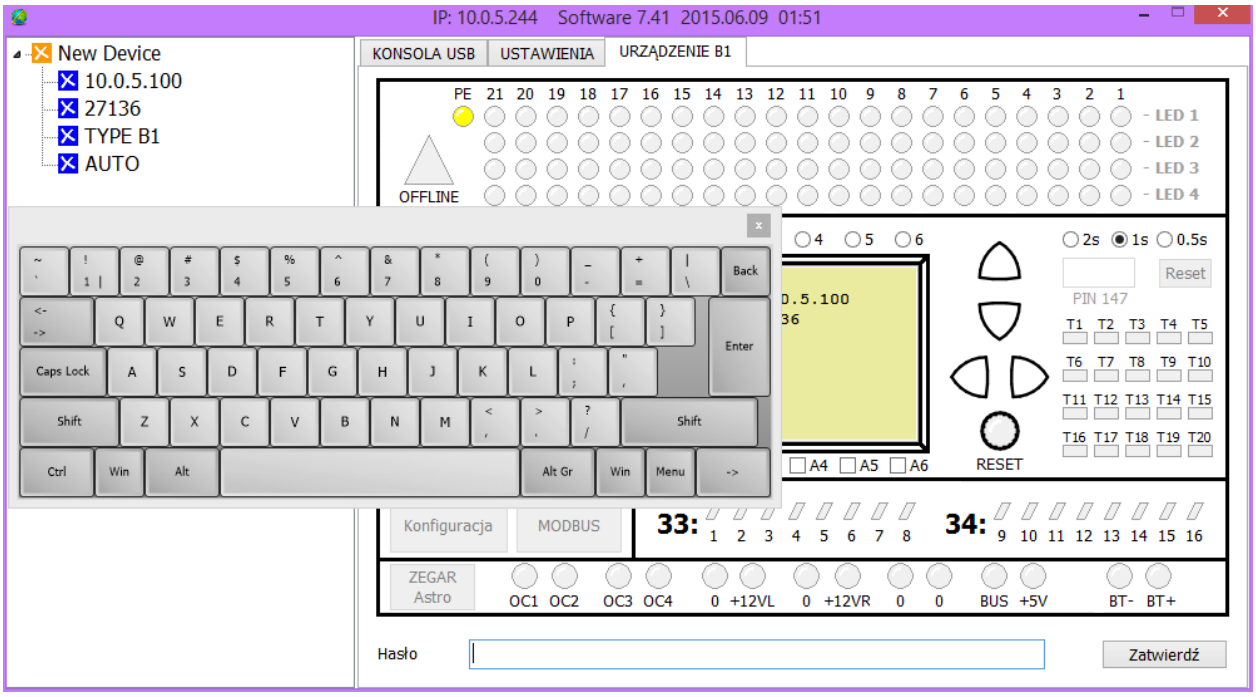
After entering everything this is how the program should look:



Of course, the IP address and port number here are just examples.

Next, you should enter the password that you had assigned to the device in the configuration using an USB cable and approve it using the “Accept” button or by pressing Enter on your keyboard.

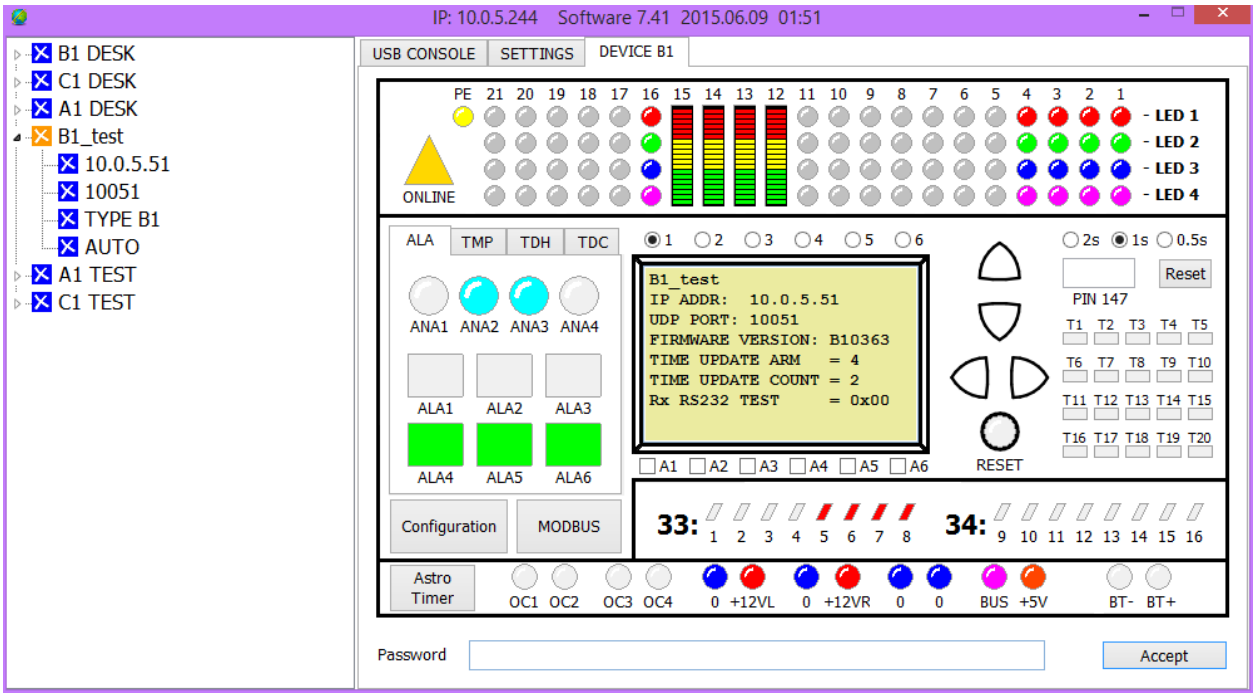
A virtual keyboard which you can also use to enter the password will appear if you double-click the field where you enter the password.



If the data in the left column are correct and so is the password, you should now achieve connection with the device.

You need to enter the password each time you run the software.
You will not be able to connect to your device if you don't.

After you enter the correct password for the chosen device, the triangular **ONLINE** light will turn yellow which means connection was achieved.



You can now start to set up your alarm.

In your device you can set up 10 zones.

- 6 alarm zones
- 4 analog alarm zones

You should start creating your own alarm by configuring the inputs.

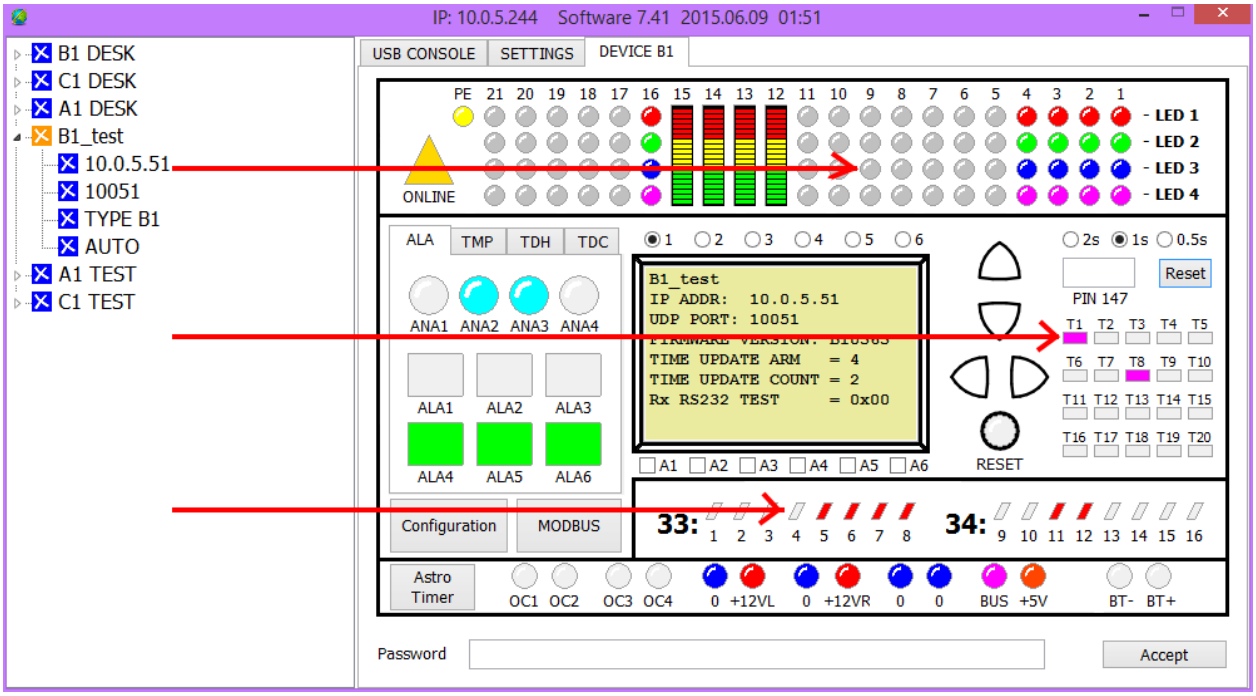
13. ALARM AND ANALOG INPUTS

The device has 21 analog inputs which recognize resistance.
To each of the inputs you can connect up to 4 sensors encoded by resistors or measure the resistance of a single element.
This way you can define 84 input circuits.

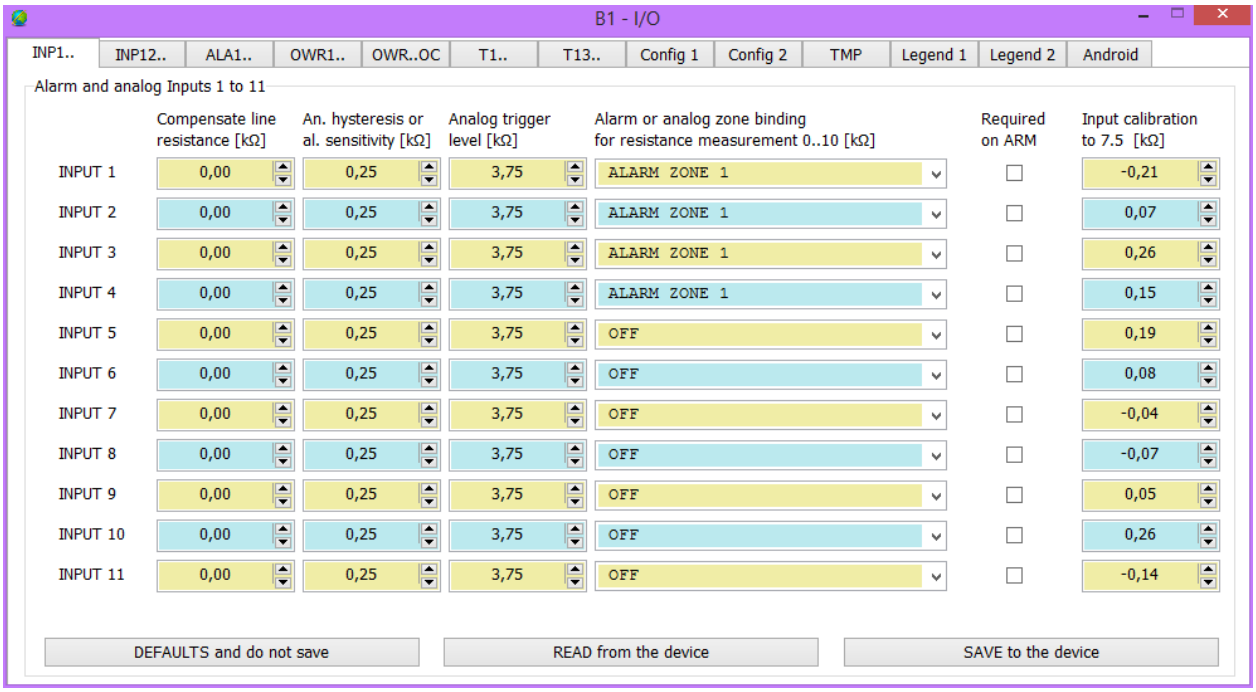
13.1. ALARM INPUT CONFIGURATION

To open the analog and alarm **input configuration window** you should put the mouse cursor on the “diodes” (circles marked with a red arrow on the picture below, described on the right side of the main window as LED1, LED2, LED3, LED4 – these names are given for easier identification of individual sensors assigned to inputs) – in any place where the cursor changes to a “hand” and then double-click the left mouse button.

You can also click on one of the rectangles representing timers T1 – T20 or the lights representing 1-Wire inputs or outputs – the same input and variable configuration window will open.



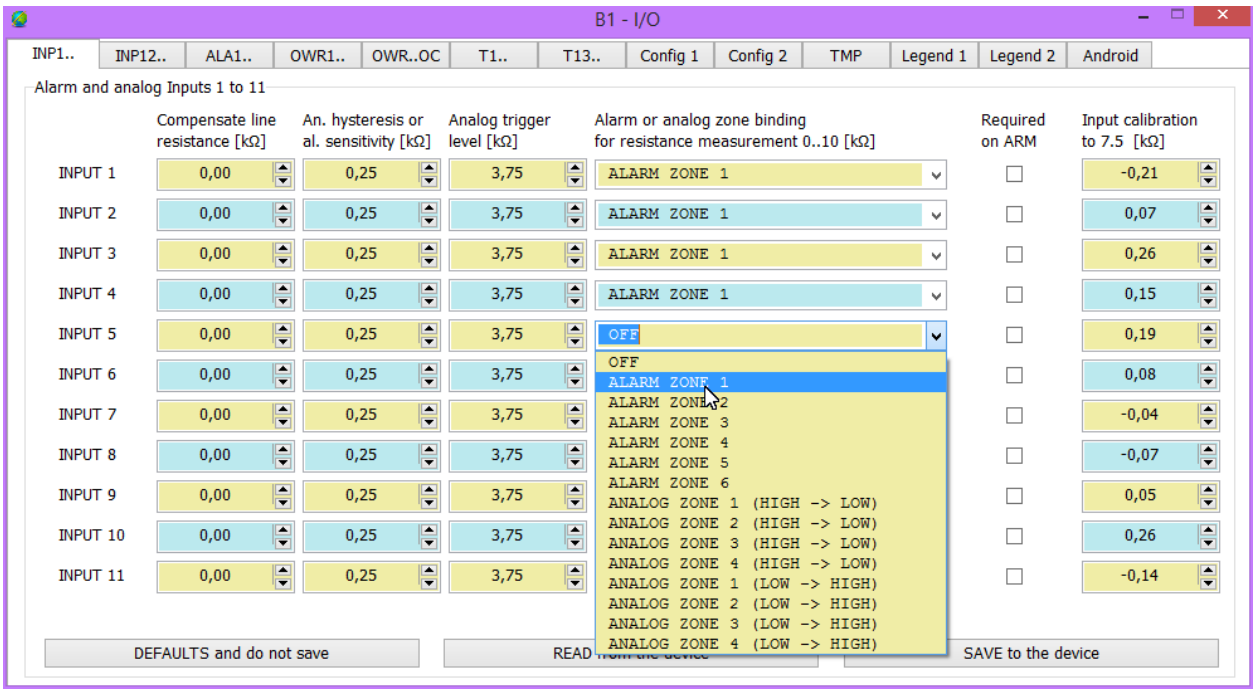
After you click, a new window with input and variable configuration parameters will pop out.


B1 - I/O
INP1..
INP12..
ALA1..
OWR1..
OWR..OC
T1..
T13..
Config 1
Config 2
TMP
Legend 1
Legend 2
Android
Alarm and analog Inputs 1 to 11
Compensate line resistance [kΩ]
An. hysteresis or al. sensitivity [kΩ]
Analog trigger level [kΩ]
Alarm or analog zone binding for resistance measurement 0..10 [kΩ]
Required on ARM
Input calibration to 7.5 [kΩ]
INPUT 1 0,00 0,25 3,75 ALARM ZONE 1 -0,21
INPUT 2 0,00 0,25 3,75 ALARM ZONE 1 0,07
INPUT 3 0,00 0,25 3,75 ALARM ZONE 1 0,26
INPUT 4 0,00 0,25 3,75 ALARM ZONE 1 0,15
INPUT 5 0,00 0,25 3,75 OFF 0,19
INPUT 6 0,00 0,25 3,75 OFF 0,08
INPUT 7 0,00 0,25 3,75 OFF -0,04
INPUT 8 0,00 0,25 3,75 OFF -0,07
INPUT 9 0,00 0,25 3,75 OFF 0,05
INPUT 10 0,00 0,25 3,75 OFF 0,26
INPUT 11 0,00 0,25 3,75 OFF -0,14
DEFAULTS and do not save
READ from the device
SAVE to the device

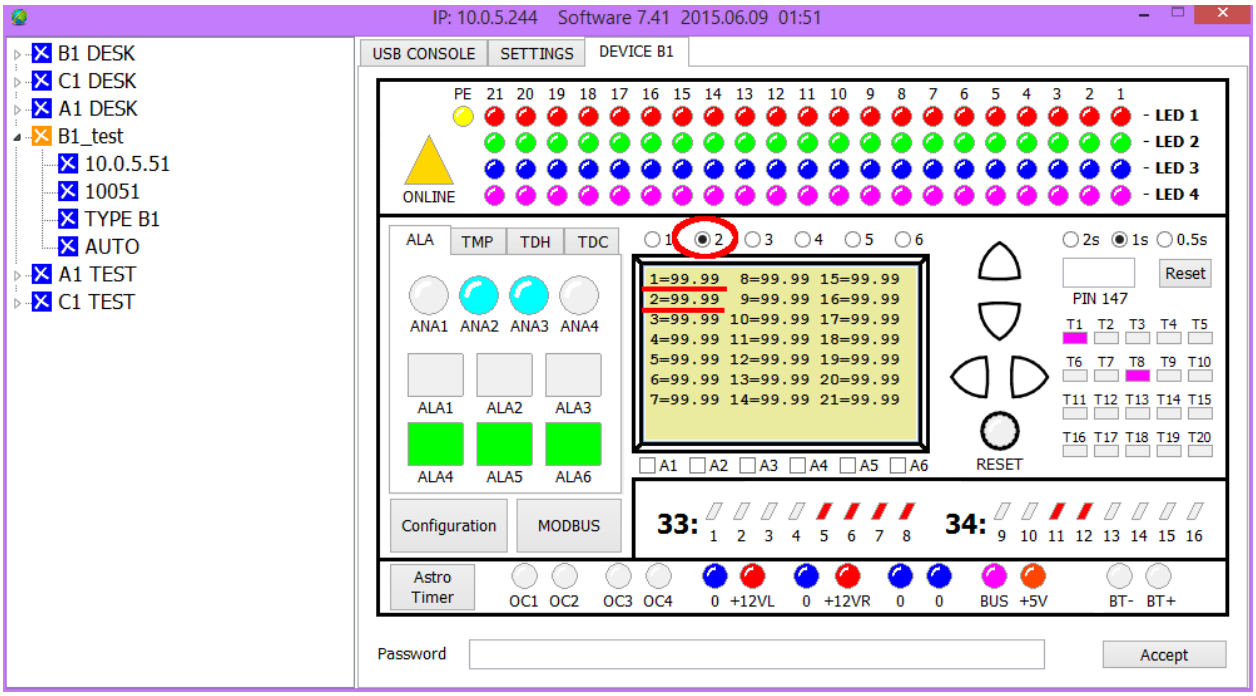
On the top, the first two tabs are used for alarm and analog input configuration:

- the first tab for inputs 1 – 11
- the second tab for inputs 12 – 21

At first, assign all inputs to one alarm zone, e.g. “ALARM ZONE 1” to calibrate resistance measurement.


B1 - I/O
INP1..
INP12..
ALA1..
OWR1..
OWR..OC
T1..
T13..
Config 1
Config 2
TMP
Legend 1
Legend 2
Android
Alarm and analog Inputs 1 to 11
Compensate line resistance [kΩ]
An. hysteresis or al. sensitivity [kΩ]
Analog trigger level [kΩ]
Alarm or analog zone binding for resistance measurement 0..10 [kΩ]
Required on ARM
Input calibration to 7.5 [kΩ]
INPUT 1 0,00 0,25 3,75 ALARM ZONE 1 -0,21
INPUT 2 0,00 0,25 3,75 ALARM ZONE 1 0,07
INPUT 3 0,00 0,25 3,75 ALARM ZONE 1 0,26
INPUT 4 0,00 0,25 3,75 ALARM ZONE 1 0,15
INPUT 5 0,00 0,25 3,75 OFF 0,19
INPUT 6 0,00 0,25 3,75 0,08
INPUT 7 0,00 0,25 3,75 -0,04
INPUT 8 0,00 0,25 3,75 -0,07
INPUT 9 0,00 0,25 3,75 0,05
INPUT 10 0,00 0,25 3,75 0,26
INPUT 11 0,00 0,25 3,75 -0,14
OFF
ALARM ZONE 1
ALARM ZONE 2
ALARM ZONE 3
ALARM ZONE 4
ALARM ZONE 5
ALARM ZONE 6
ANALOG ZONE 1 (HIGH -> LOW)
ANALOG ZONE 2 (HIGH -> LOW)
ANALOG ZONE 3 (HIGH -> LOW)
ANALOG ZONE 4 (HIGH -> LOW)
ANALOG ZONE 1 (LOW -> HIGH)
ANALOG ZONE 2 (LOW -> HIGH)
ANALOG ZONE 3 (LOW -> HIGH)
ANALOG ZONE 4 (LOW -> HIGH)
DEFAULTS and do not save
SAVE to the device

This is needed for resistances of individual lines from 1 to 21 to be shown in window 2 on the display in the main window of the software.



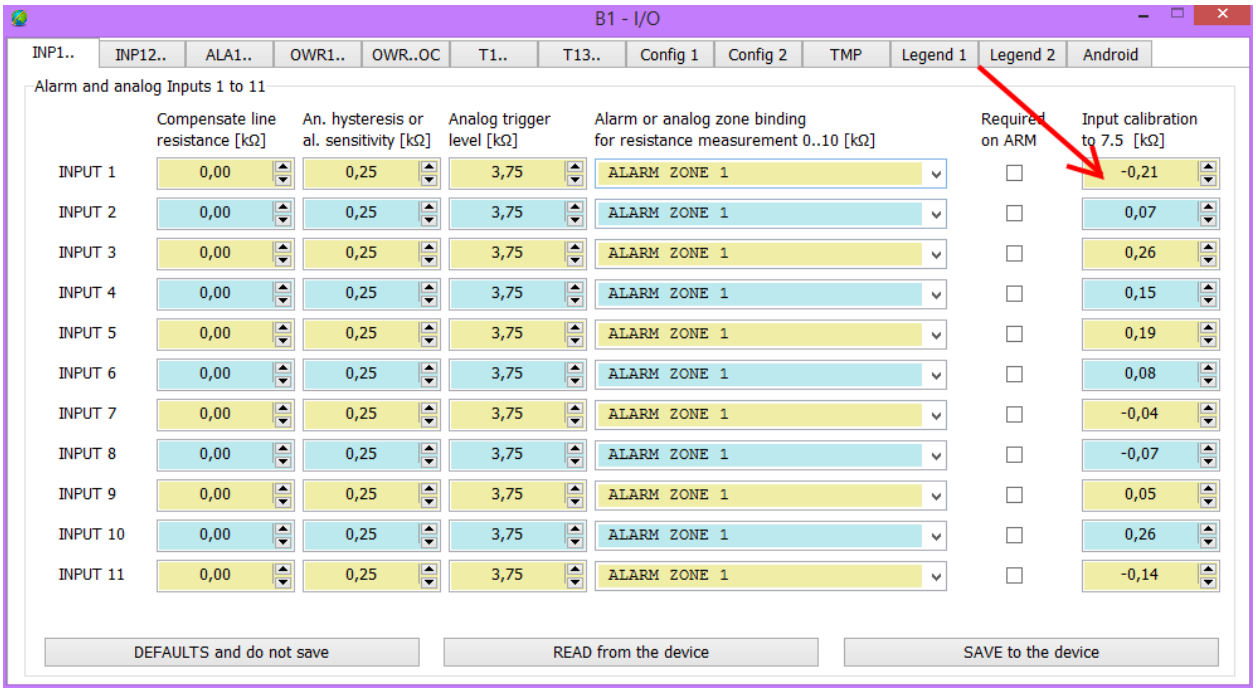
13.1.1. Input calibration

Next, you should calibrate the inputs.

Simplifying, you need to 'teach' them how much precisely is 7.5kΩ.
To do this, you need to use the 7.5kΩ resistor that you received with the device. The resistor should be connected between the ground (pin 22) and the calibrated input. See what the reading is and enter the correction, saving it to the device every time. The value should be around 7.5kΩ.

Calibration should be done once, before you connect any alarm sensor or reed switch circuits.

Calibration is necessary as every input must precisely recognize the range of resistance in the given wire. Without calibration the device will react correctly if there is a disturbance in the alarm zone, but it will not be able to say exactly e.g. which sensor in the window caused the alarm, which window is open.

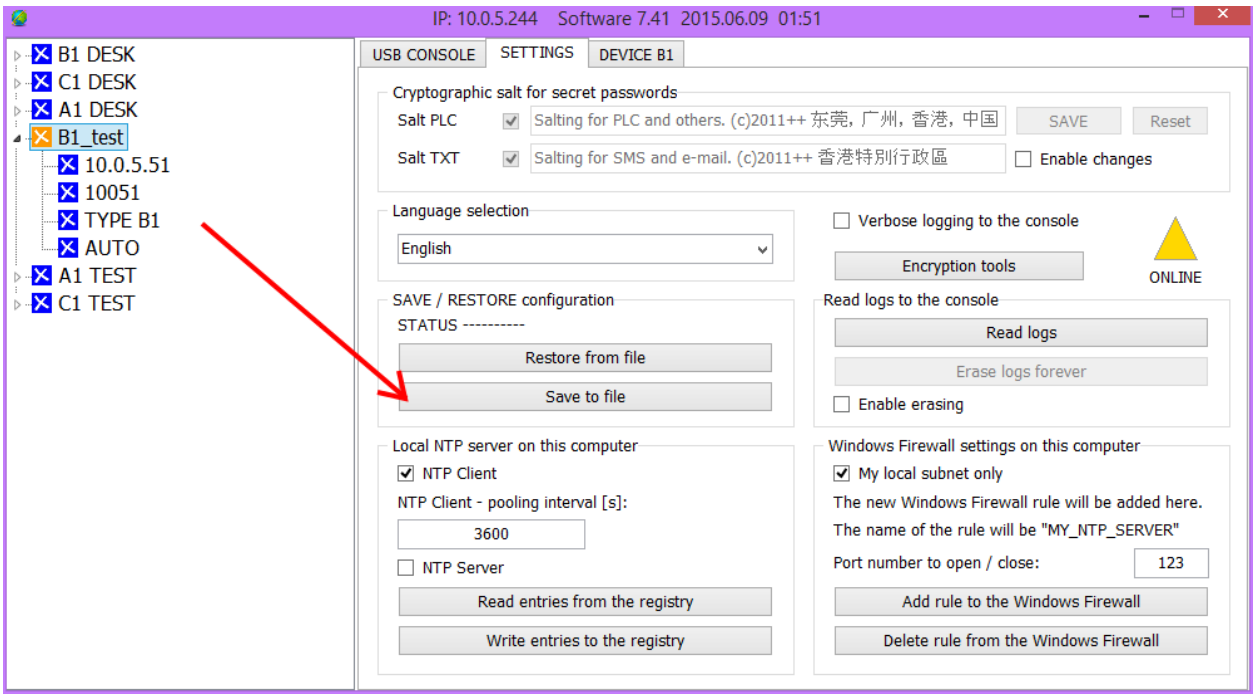

B1 - I/O
INP1..
INP12..
ALA1..
OWR1..
OWR..OC
T1..
T13..
Config 1
Config 2
TMP
Legend 1
Legend 2
Android
Alarm and analog Inputs 1 to 11
Compensate line resistance [kΩ]
An. hysteresis or al. sensitivity [kΩ]
Analog trigger level [kΩ]
Alarm or analog zone binding for resistance measurement 0..10 [kΩ]
Required on ARM
Input calibration to 7.5 [kΩ]
INPUT 1 0,00 0,25 3,75 ALARM ZONE 1 -0,21
INPUT 2 0,00 0,25 3,75 ALARM ZONE 1 0,07
INPUT 3 0,00 0,25 3,75 ALARM ZONE 1 0,26
INPUT 4 0,00 0,25 3,75 ALARM ZONE 1 0,15
INPUT 5 0,00 0,25 3,75 ALARM ZONE 1 0,19
INPUT 6 0,00 0,25 3,75 ALARM ZONE 1 0,08
INPUT 7 0,00 0,25 3,75 ALARM ZONE 1 -0,04
INPUT 8 0,00 0,25 3,75 ALARM ZONE 1 -0,07
INPUT 9 0,00 0,25 3,75 ALARM ZONE 1 0,05
INPUT 10 0,00 0,25 3,75 ALARM ZONE 1 0,26
INPUT 11 0,00 0,25 3,75 ALARM ZONE 1 -0,14
DEFAULTS and do not save
READ from the device
SAVE to the device

A detailed input calibration video manual is available on You Tube.

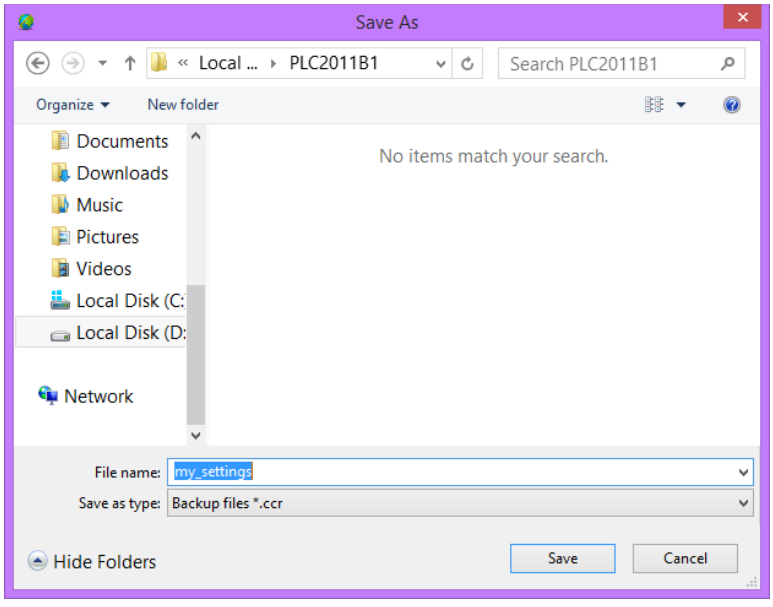
13.1.2. Saving the configuration

You can save the input calibration settings to a file so that you can retrieve them if they are lost. They will be stored in the device.

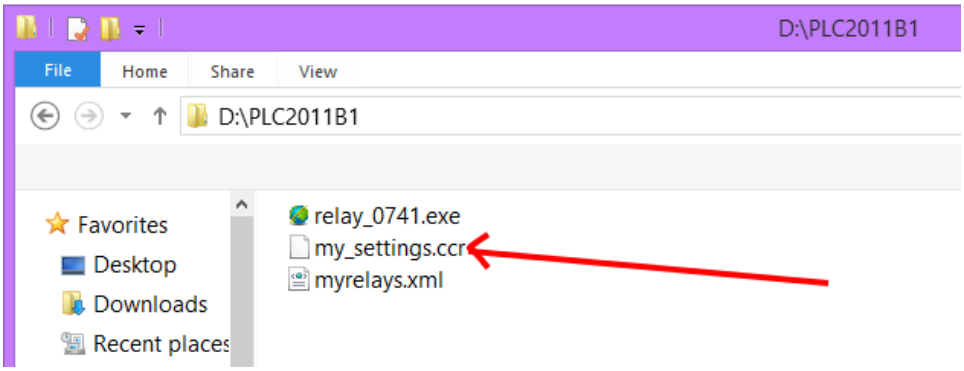
You save to file in the **SETTINGS** tab.
Calibration parameters will not disappear when you disconnect the power supply. They can be stored and retrieved from a file together with other parameters of the given device.
Remember that when you copy configuration from one device to another, the calibration parameters will also be copied. However, they will be incorrect for the second device.



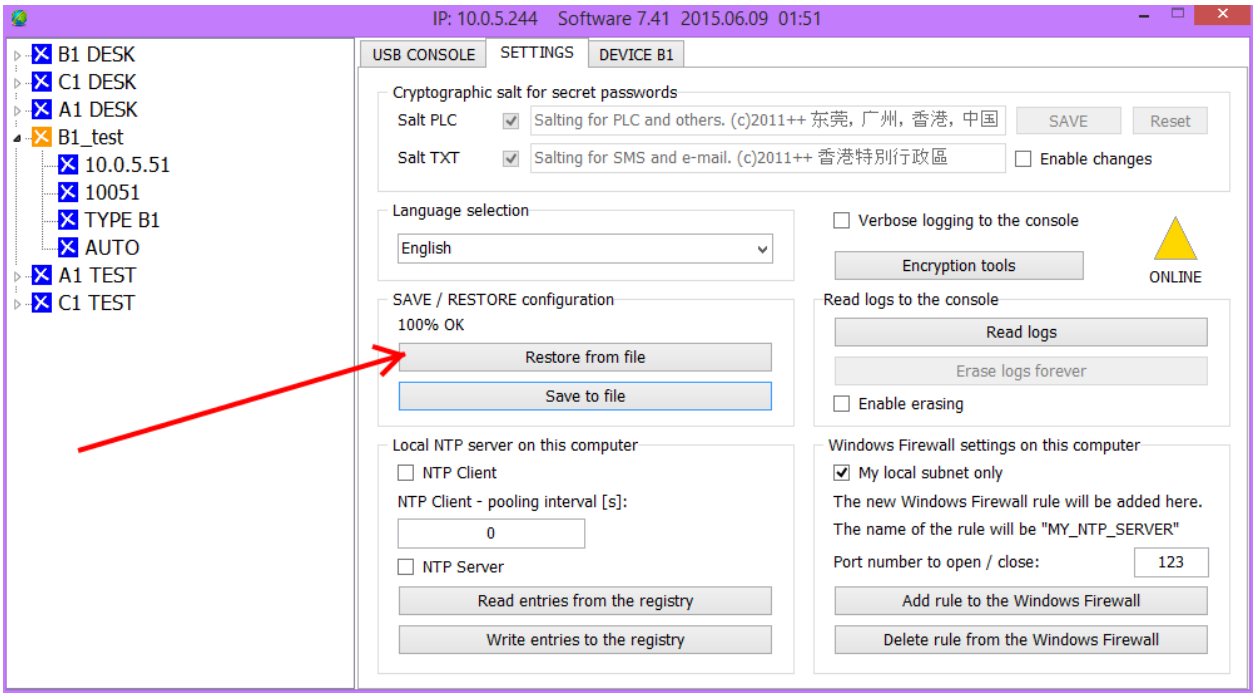
After clicking 'Save to file' you will be asked to give a location and file name.



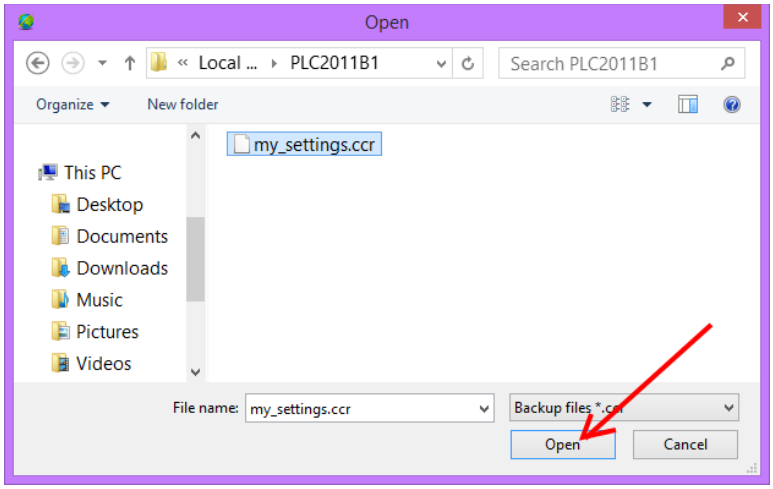
After accepting, a ".ccr" file with your configuration will show up in the specified location.



To load them again you need to go to the **SETTINGS** tab and click the 'Restore from file' button.



Then find the folder where you saved the file and pick it from the file list.



After pressing 'Open' the file will be loaded and the device will restart itself. This will not be immediate, it may take several seconds.

13.1.3. Alarm input sensitivity

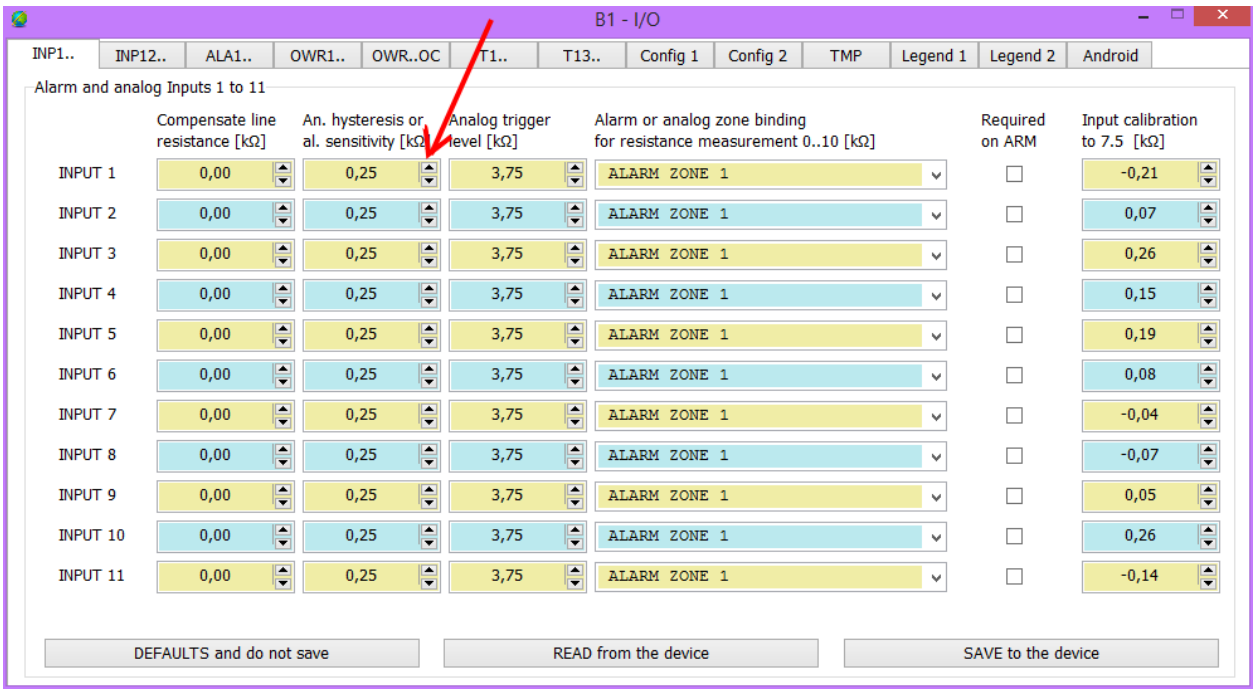
If you want the inputs to work as alarm inputs and recognize each of the four connected sensors then the '**Analog hysteresis or alarm sensitivity**' column is important.

If the input works as an alarm input then this column set it's sensitivity for resistance changes.

If it's supposed to work as analog then you can set a hysteresis between on and off state.

Alarm input sensitivity defines how much must the resistance change for the alarm to be triggered.

The value of 0.25kΩ is a default value.
It means that if the resistance changes by 0.25kΩ, the alarm will be triggered.


B1 - I/O
INP1..
INP12..
ALA1..
OWR1..
OWR..OC
T1..
T13..
Config 1
Config 2
TMP
Legend 1
Legend 2
Android
Alarm and analog Inputs 1 to 11
Compensate line resistance [kΩ]
An. hysteresis or al. sensitivity [kΩ]
Analog trigger level [kΩ]
Alarm or analog zone binding for resistance measurement 0..10 [kΩ]
Required on ARM
Input calibration to 7.5 [kΩ]
INPUT 1 0,00 0,25 3,75 ALARM ZONE 1 -0,21
INPUT 2 0,00 0,25 3,75 ALARM ZONE 1 0,07
INPUT 3 0,00 0,25 3,75 ALARM ZONE 1 0,26
INPUT 4 0,00 0,25 3,75 ALARM ZONE 1 0,15
INPUT 5 0,00 0,25 3,75 ALARM ZONE 1 0,19
INPUT 6 0,00 0,25 3,75 ALARM ZONE 1 0,08
INPUT 7 0,00 0,25 3,75 ALARM ZONE 1 -0,04
INPUT 8 0,00 0,25 3,75 ALARM ZONE 1 -0,07
INPUT 9 0,00 0,25 3,75 ALARM ZONE 1 0,05
INPUT 10 0,00 0,25 3,75 ALARM ZONE 1 0,26
INPUT 11 0,00 0,25 3,75 ALARM ZONE 1 -0,14
DEFAULTS and do not save
READ from the device
SAVE to the device

You can set any value with precision up to 0.01kΩ.
If the sensitivity is too high, false alarms may occur.

ATTENTION!

Please remember that close proximity of WiFi routers, GSM modems, GSM dialers or other electromagnetic wave sources may cause false alarms. There was a case with a microwave oven behind the wall, in the kitchen of a neighboring apartment. When designing the alarm installation you need to predict potential disturbance sources. You should not have alarm wiring next to electric wiring and there should be as big of a gap between them as possible. A screened cable should be used when necessary and the transmitter should be placed at certain distances.

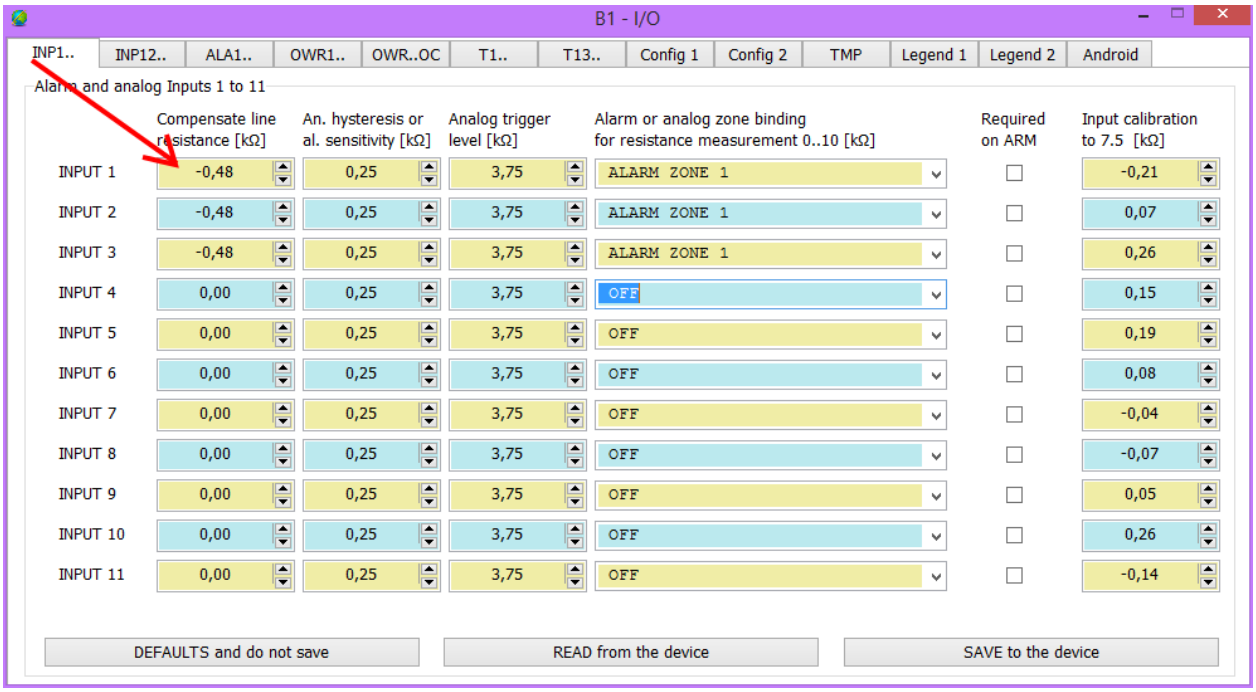
13.1.4. Line resistance compensation

An alarm line should not have a resistance close to 0. When all reed switches and sensor relays are in the normal state and are closed then the resistance equals the resistance of the cords. This is usually from a couple to over a dozen Ω.

This is not desired as intentionally shorting the cords may not trigger an alarm. Due to this, you should add a resistor in a series with the device's input so that the resistance of the line is equal to a couple of hundred Ω when the alarm is armed. This way both the rise and fall of resistance will cause the alarm to be triggered.

In the example below a 470Ω resistor was added and 480Ω were subtracted, 10Ω as the cord resistance and 470Ω as the rest.

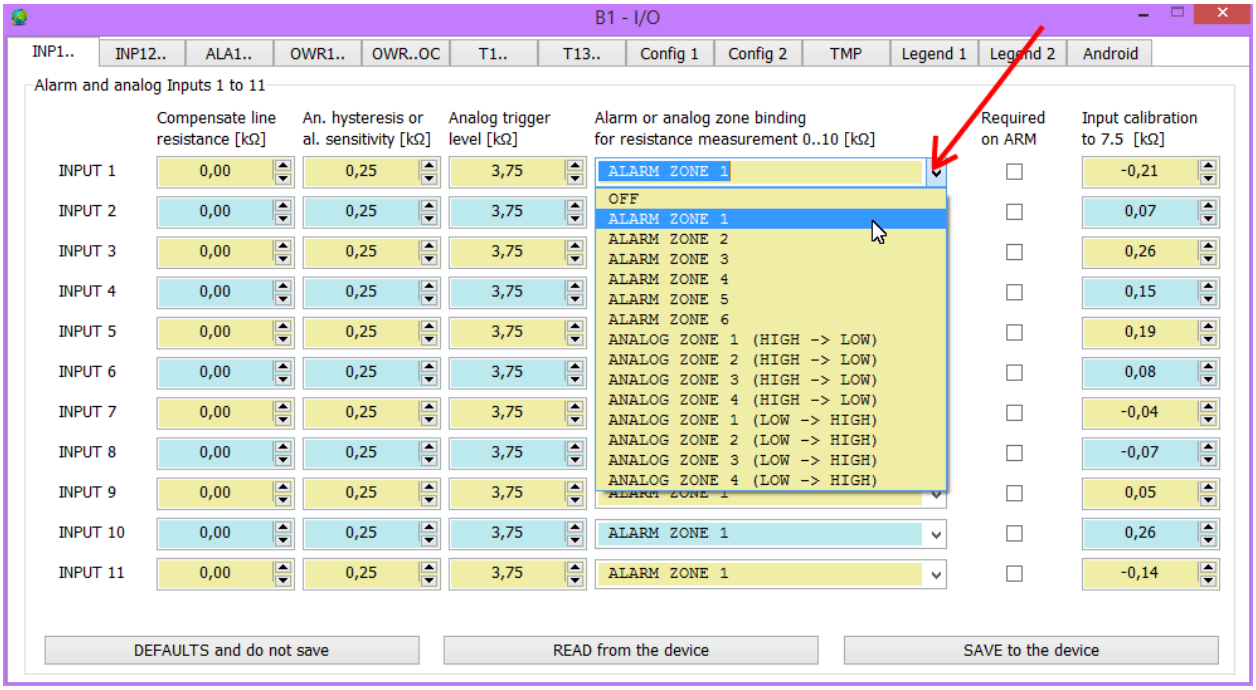
You need to keep an eye on the resistance readings so that when the windows are closed and sensors are inactive the resistance is 0.


B1 - I/O
INP1..
INP12..
ALA1..
OWR1..
OWR..OC
T1..
T13..
Config 1
Config 2
TMP
Legend 1
Legend 2
Android
Alarm and analog Inputs 1 to 11
Compensate line resistance [kΩ]
An. hysteresis or al. sensitivity [kΩ]
Analog trigger level [kΩ]
Alarm or analog zone binding for resistance measurement 0..10 [kΩ]
Required on ARM
Input calibration to 7.5 [kΩ]
INPUT 1 -0,48 0,25 3,75 ALARM ZONE 1 -0,21
INPUT 2 -0,48 0,25 3,75 ALARM ZONE 1 0,07
INPUT 3 -0,48 0,25 3,75 ALARM ZONE 1 0,26
INPUT 4 0,00 0,25 3,75 OFF 0,15
INPUT 5 0,00 0,25 3,75 OFF 0,19
INPUT 6 0,00 0,25 3,75 OFF 0,08
INPUT 7 0,00 0,25 3,75 OFF -0,04
INPUT 8 0,00 0,25 3,75 OFF -0,07
INPUT 9 0,00 0,25 3,75 OFF 0,05
INPUT 10 0,00 0,25 3,75 OFF 0,26
INPUT 11 0,00 0,25 3,75 OFF -0,14
DEFAULTS and do not save
READ from the device
SAVE to the device

From this moment you can observe every opening, half-opening or unsealing of the window and the status of the rest of the sensors. Every time there is a resistance change you will see an information on your PC or mobile phone.

13.1.5. Binding inputs to alarm zones

In the next column you can bind individual inputs to alarm zones.


B1 - I/O
INP1..
INP12..
ALA1..
OWR1..
OWR..OC
T1..
T13..
Config 1
Config 2
TMP
Legend 1
Legend 2
Android
Alarm and analog Inputs 1 to 11
Compensate line resistance [kΩ]
An. hysteresis or al. sensitivity [kΩ]
Analog trigger level [kΩ]
Alarm or analog zone binding for resistance measurement 0..10 [kΩ]
Required on ARM
Input calibration to 7.5 [kΩ]
INPUT 1 0,00 0,25 3,75 ALARM ZONE 1 -0,21
INPUT 2 0,00 0,25 3,75 0,07
INPUT 3 0,00 0,25 3,75 0,26
INPUT 4 0,00 0,25 3,75 0,15
INPUT 5 0,00 0,25 3,75 0,19
INPUT 6 0,00 0,25 3,75 0,08
INPUT 7 0,00 0,25 3,75 -0,04
INPUT 8 0,00 0,25 3,75 -0,07
INPUT 9 0,00 0,25 3,75 0,05
INPUT 10 0,00 0,25 3,75 ALARM ZONE 1 0,26
INPUT 11 0,00 0,25 3,75 ALARM ZONE 1 -0,14
OFF
ALARM ZONE 1
ALARM ZONE 2
ALARM ZONE 3
ALARM ZONE 4
ALARM ZONE 5
ALARM ZONE 6
ANALOG ZONE 1 (HIGH -> LOW)
ANALOG ZONE 2 (HIGH -> LOW)
ANALOG ZONE 3 (HIGH -> LOW)
ANALOG ZONE 4 (HIGH -> LOW)
ANALOG ZONE 1 (LOW -> HIGH)
ANALOG ZONE 2 (LOW -> HIGH)
ANALOG ZONE 3 (LOW -> HIGH)
ANALOG ZONE 4 (LOW -> HIGH)
DEFAULTS and do not save
READ from the device
SAVE to the device

After clicking the left mouse button in the place pointed to on the picture with a red arrow, a list will appear from which you can chose where do you want to assign the input. Because you are now configuring alarm, you should bind an input with an alarm zone.

You can choose from one of the six alarm zones:
- **ALARM ZONE 1** to **ALARM ZONE 6**.

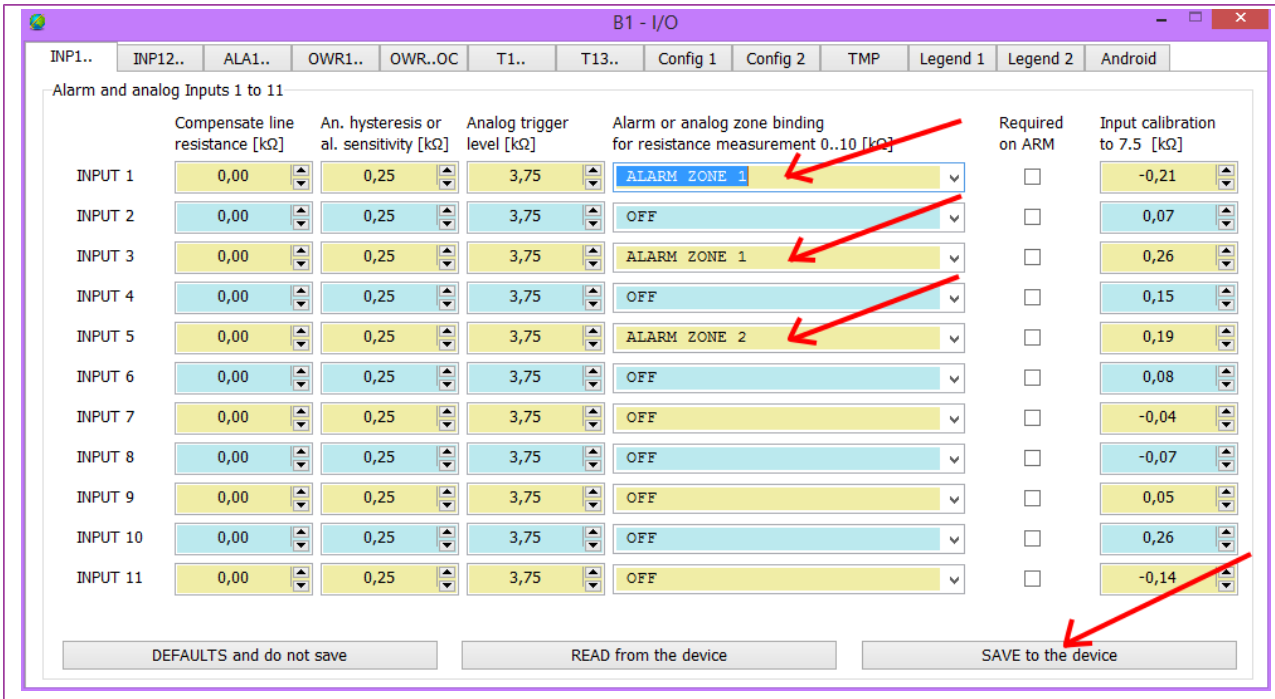
What is an alarm zone?

In this case it is a collection of inputs with connected sensors (reed switches in windows or doors, motion sensors, smoke sensors etc.), which you can arm and disarm simultaneously by clicking one zone button. You can bind only one input to an alarm zone or you can bind all of them. How a zone is configured and what sensors are assigned to it is only up to the user.

For example, to one zone you can assign all windows, to a second all smoke detectors and motion sensors to a third. You can also treat separate rooms as separate zones.
It all depends on your needs and the specifics of a given building.

Defining too many alarm zones is not smart as it will make exploitation harder. You can change the alarm zone configuration at any time, without switching any cords. Just remember that sensors connected to one input cannot be divided into different alarm zones.

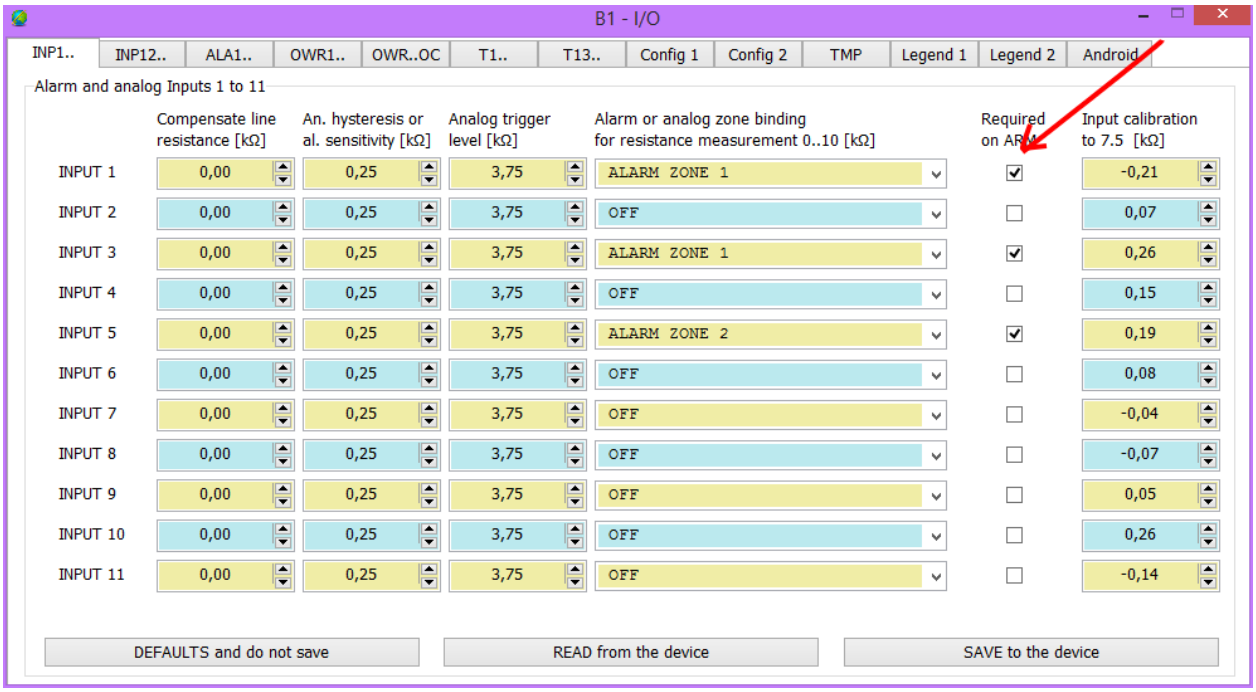
To bind an input to an alarm zone you need to choose one of the alarm zones from the list and save the setting with the 'Save to the device' button.


B1 - I/O
INP1..
INP12..
ALA1..
OWR1..
OWR..OC
T1..
T13..
Config 1
Config 2
TMP
Legend 1
Legend 2
Android
Alarm and analog Inputs 1 to 11
Compensate line resistance [kΩ]
An. hysteresis or al. sensitivity [kΩ]
Analog trigger level [kΩ]
Alarm or analog zone binding for resistance measurement 0..10 [kΩ]
Required on ARM
Input calibration to 7.5 [kΩ]
INPUT 1 0,00 0,25 3,75 ALARM ZONE 1 -0,21
INPUT 2 0,00 0,25 3,75 OFF 0,07
INPUT 3 0,00 0,25 3,75 ALARM ZONE 1 0,26
INPUT 4 0,00 0,25 3,75 OFF 0,15
INPUT 5 0,00 0,25 3,75 ALARM ZONE 2 0,19
INPUT 6 0,00 0,25 3,75 OFF 0,08
INPUT 7 0,00 0,25 3,75 OFF -0,04
INPUT 8 0,00 0,25 3,75 OFF -0,07
INPUT 9 0,00 0,25 3,75 OFF 0,05
INPUT 10 0,00 0,25 3,75 OFF 0,26
INPUT 11 0,00 0,25 3,75 OFF -0,14
DEFAULTS and do not save
READ from the device
SAVE to the device

In the picture, inputs 1 and 3 are assigned to ALARM ZONE 1 while input 5 is bound to ALARM ZONE2.

Remember to always save the settings.

13.1.6. Required on ARM


B1 - I/O
INP1..
INP12..
ALA1..
OWR1..
OWR..OC
T1..
T13..
Config 1
Config 2
TMP
Legend 1
Legend 2
Android
Alarm and analog Inputs 1 to 11
Compensate line resistance [kΩ]
An. hysteresis or al. sensitivity [kΩ]
Analog trigger level [kΩ]
Alarm or analog zone binding for resistance measurement 0..10 [kΩ]
Required on ARM
Input calibration to 7.5 [kΩ]
INPUT 1 0,00 0,25 3,75 ALARM ZONE 1 -0,21
INPUT 2 0,00 0,25 3,75 OFF 0,07
INPUT 3 0,00 0,25 3,75 ALARM ZONE 1 0,26
INPUT 4 0,00 0,25 3,75 OFF 0,15
INPUT 5 0,00 0,25 3,75 ALARM ZONE 2 0,19
INPUT 6 0,00 0,25 3,75 OFF 0,08
INPUT 7 0,00 0,25 3,75 OFF -0,04
INPUT 8 0,00 0,25 3,75 OFF -0,07
INPUT 9 0,00 0,25 3,75 OFF 0,05
INPUT 10 0,00 0,25 3,75 OFF 0,26
INPUT 11 0,00 0,25 3,75 OFF -0,14
DEFAULTS and do not save
READ from the device
SAVE to the device

If you activate this option for a given input it will mean that for the alarm zone, to which this input is assigned, to be armed, the contacts in the reed switches must be closed in windows and doors connected to this input.

In other words, if:

- you bind input 1 to ALARM ZONE 1
- you connect 2 windows with 4 reed switches to input 1 in a way that will allow the device to recognize whether the window is open or half-open
- if the **'Required on ARM' option is active**, you will not be able to arm ZONE 1 if the windows are half-open
- if the **'Required on ARM' option is not active**, you will be able to arm ZONE 1 even when the windows are half-open. The zone is armed in its current status.

Of course, in the second case, both closing and fully opening the window will trigger the alarm.

13.2. Alarm inputs 1...4 – Counters

In the **Config1** tab you can configure counters assigned to the first four alarm inputs. These counters are not too fast because of the kind of alarm line inputs used. They can count impulses up to 2Hz and can be used mainly to count slow actions such as a cycle of opening gates, doors, windows etc. These counters work only when the inputs were configured.

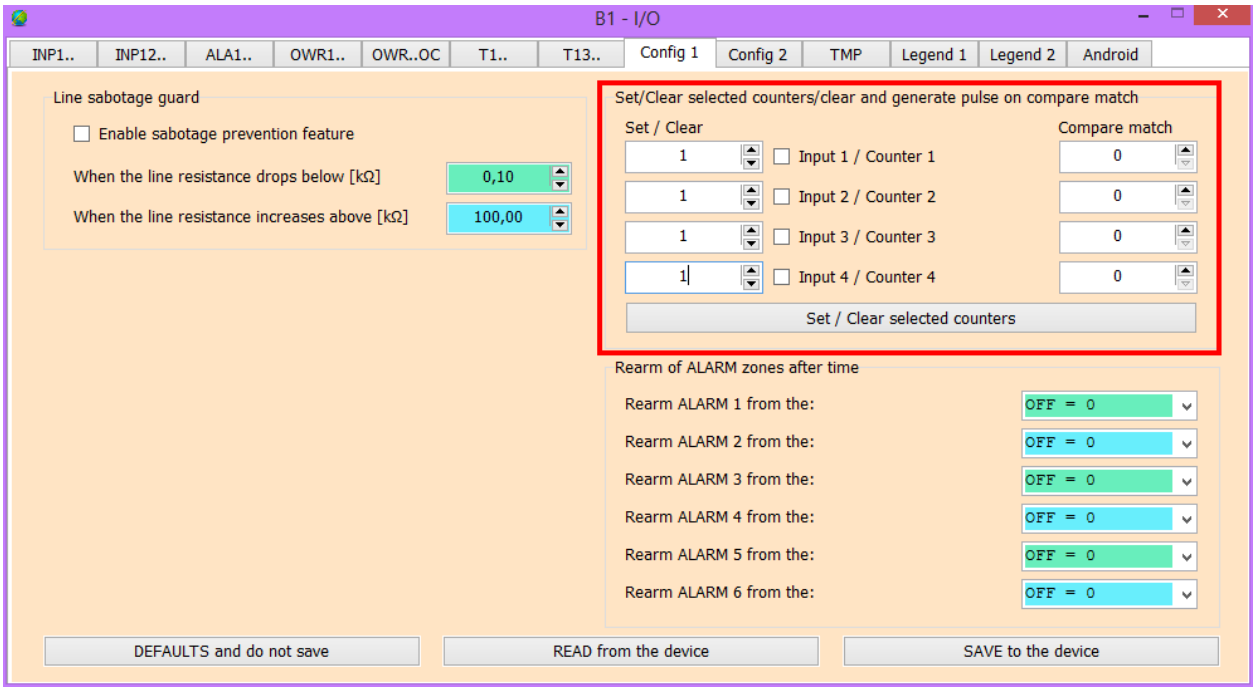
When the input is assigned to an analog zone, the moment of counting another impulse is controlled by the final analog level and the hysteresis level value. For the count to be made the resistance must cross the final analog level and then return to the hysteresis level. The impulses can be counted in both the HI->LOW and LOW->HI mode after correctly setting the resistance threshold levels.

When the input is assigned to an alarm zone, the counter will start working the set final analog level is crossed. The zone must not be armed.

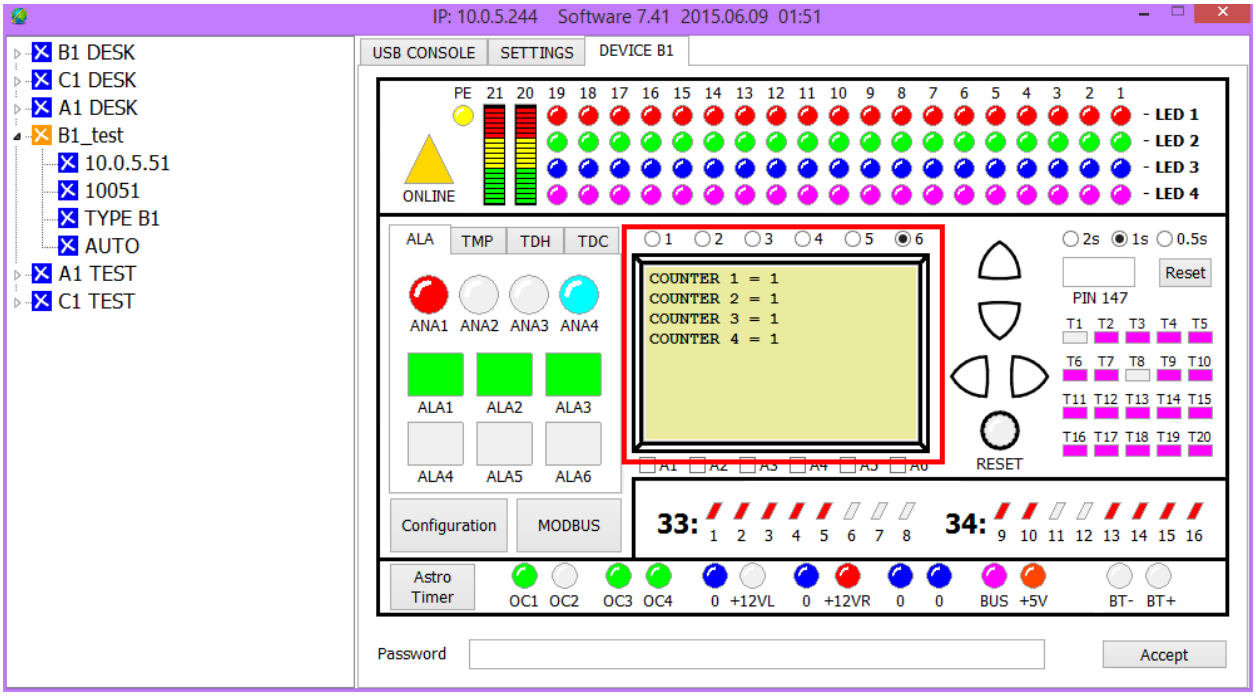
Set / Clear selected counters

You can assign a set value to every counter. This will be the value from which the counter will start counting up. If you want to manually clear the counter or set a value you should enter 0 or any other desired value and check the checkbox on the right to approve. Next press the big **Set/Clear selected counters** button.

Comparison column.
When the value is 0, the function is not active.
When the value is different than 0 then the counter will reset and start counting again every time it reaches the entered value. In the same moment variables CTC1-CTC4 will change their values to 1 and switch off when the counter gets to it's first unit.

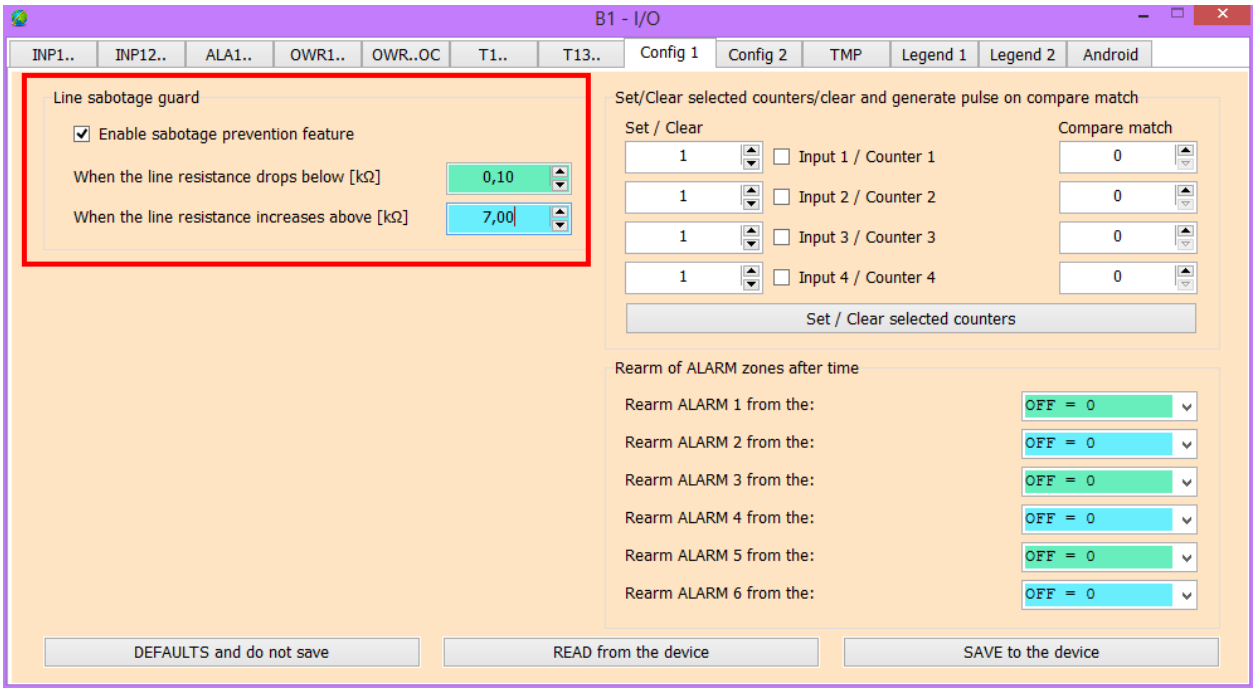


You can view the current status of the counters in the main screen of the software in screen 6.

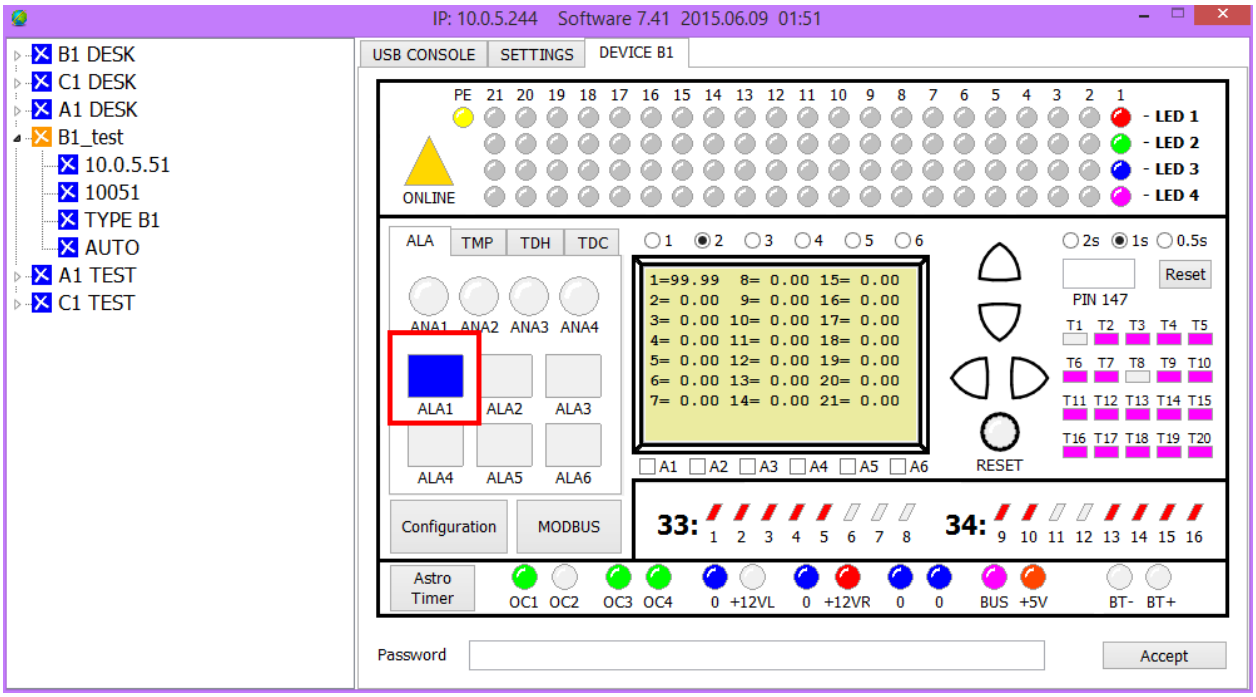


13.3. Line sabotage guard

The purpose of the **Line sabotage guard** is to detect attempts of manipulating with the wiring when the alarm zone is disarmed. To do that you set up two threshold resistance values the breaking of which will cause and alarm in the zone even if it is disarmed.



When this kind of alarm is triggered it is signaled not with red like a normal alarm but with blue. In the example shown on the previous page, the upper threshold value was set to 7kΩ. As you can see below, breaking that threshold caused an alarm.



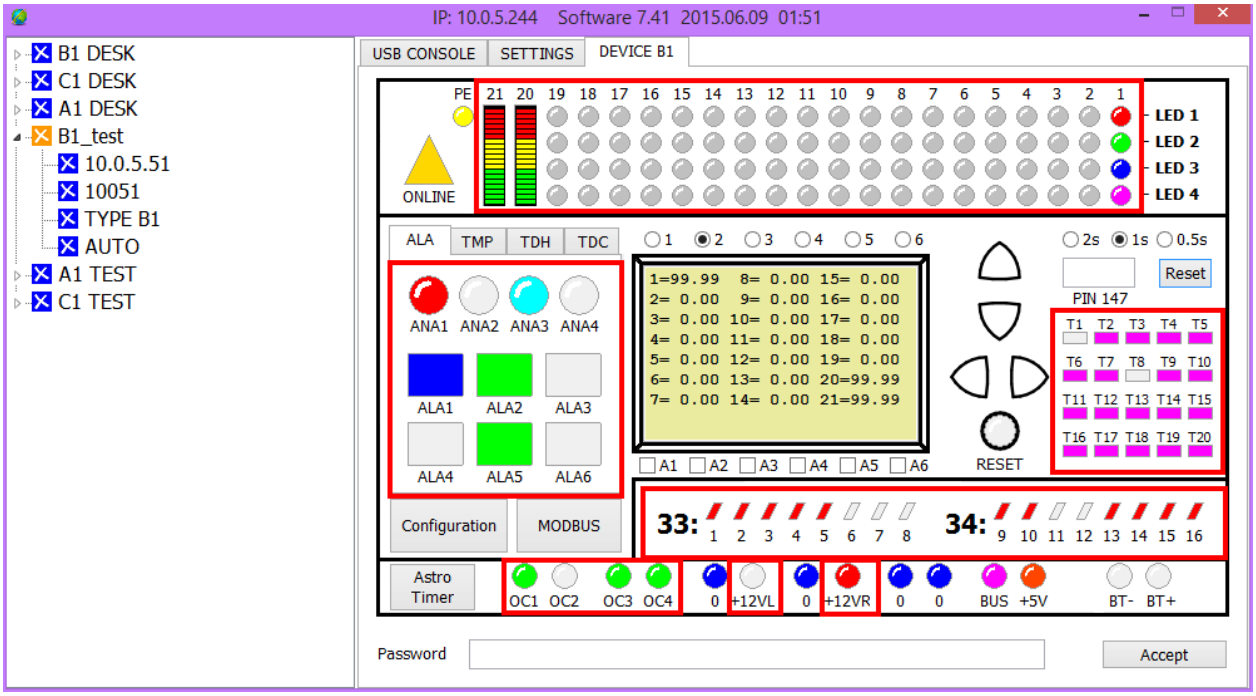
This function guarantees that any external interference in the circuits connected to the device e.g. connecting some unwanted element to the circuit, will be noticed immediately

Of course there are no perfect alarms which cannot be cheated. From time to time you should inspect all the elements of your installation yourself despite the readings of the device.

14. ASSIGNING NAMES TO SENSORS AND ALARM ZONES

In order to make it easier to bind inputs to alarm zones and to view the current status of the device, that is the status of the alarm zones, analog zones, sensors, variables and outputs, you can assign them names and descriptions which will be displayed instead of the default descriptions in the software. This will simplify and accelerate identifying and locating the alarm if it occurs.

Names can be assigned to all elements marked with a red frame on the picture below.

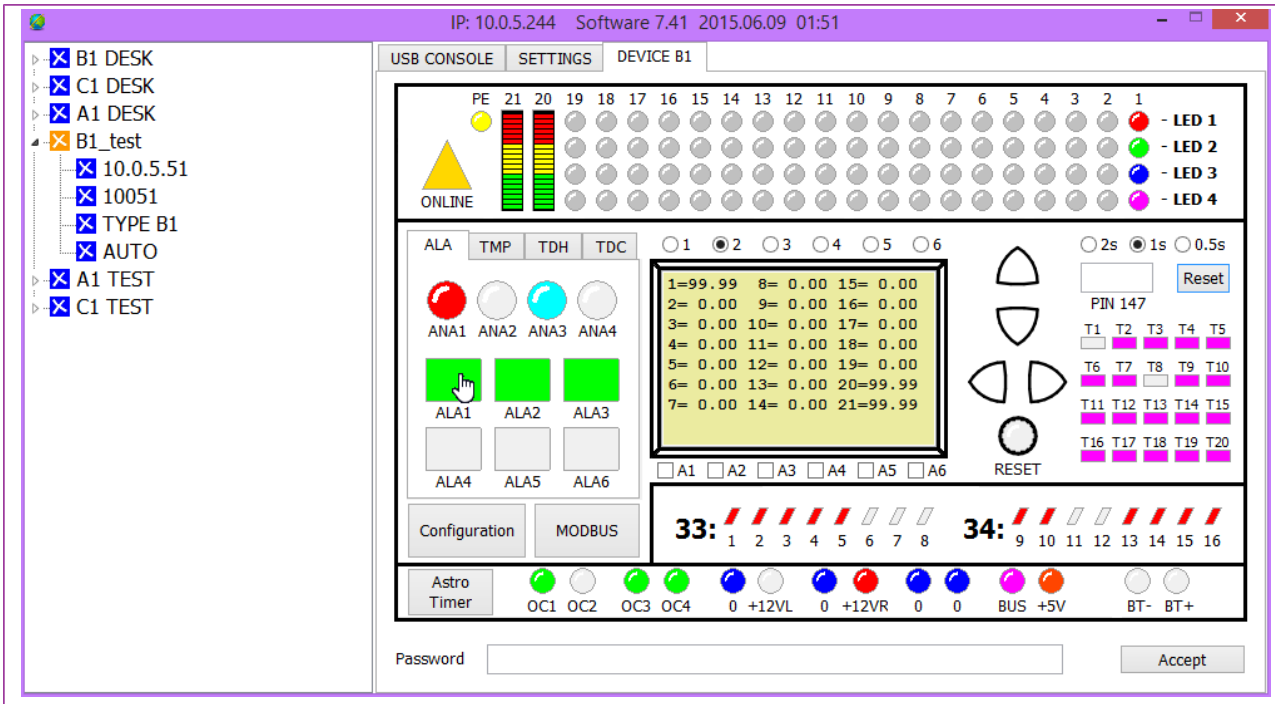


- all alarm zones
- all analog zones
- inputs configured as an analog input
- 4 LEDs (sensors, reed switches etc.) on every input configured as an alarm input
- variables from T1 to T20
- 4 open collector outputs
- 2 12V power supply outputs
- 16 1-Wire inputs/outputs

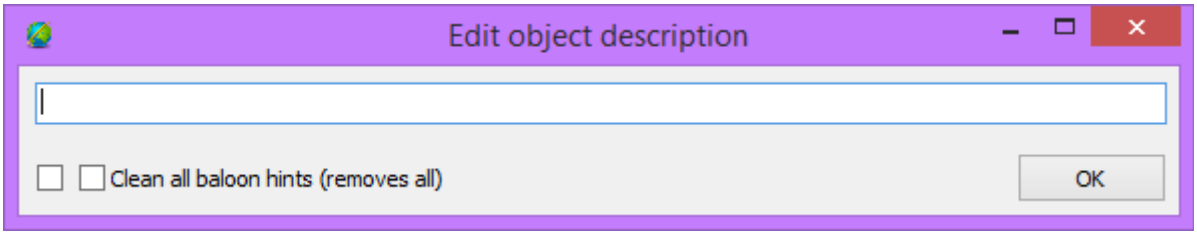
To assign a name to a chosen element you should put the mouse cursor over it in the main window of the program, so that the cursor changes to a hand.

In this example, the ALARM 1 button representing alarm zone 1 is used.

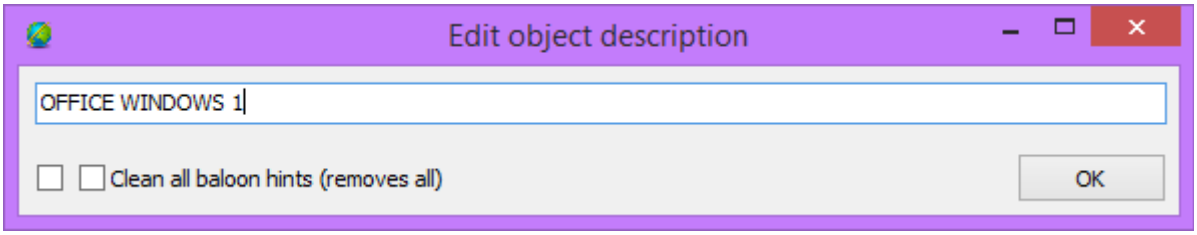
In this place click the right mouse button.



This window will pop out:



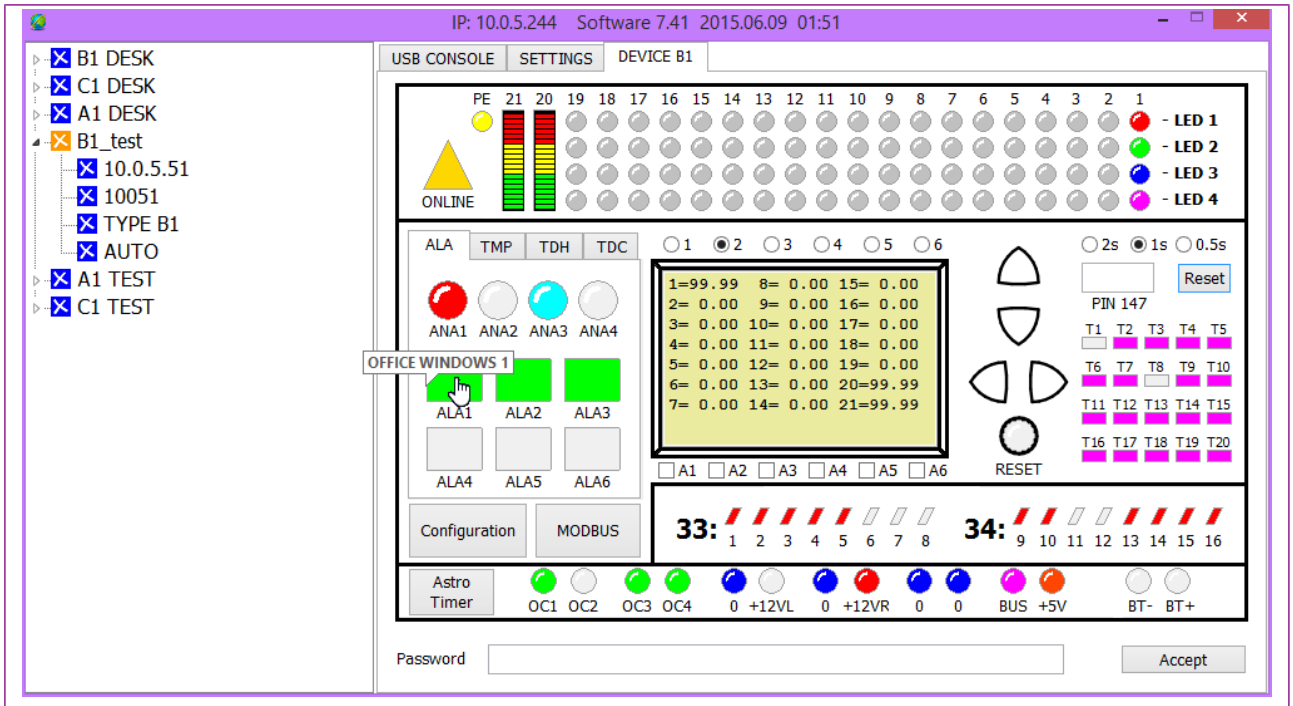
Here you can enter a text you want to be displayed when you put the mouse cursor over the element.
For example, you can enter:



Press OK so the name is saved.

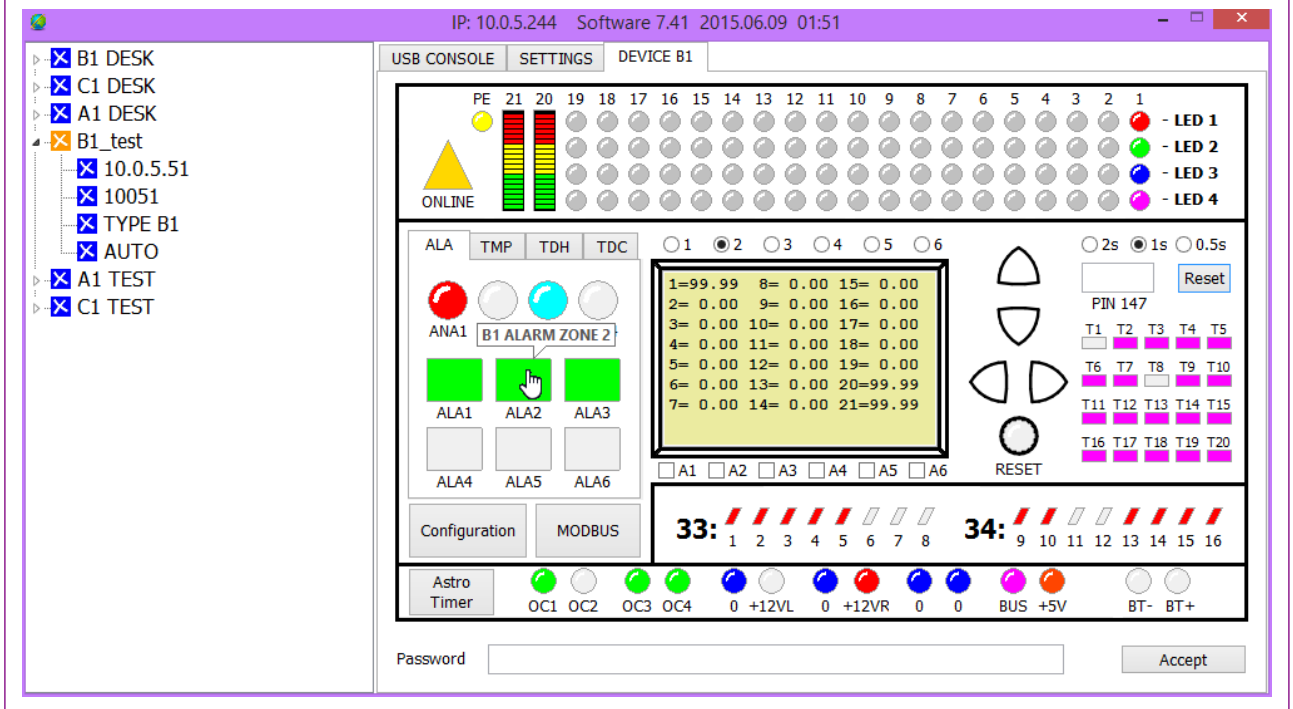
Now, when you put your mouse cursor over the ALARM 1 button a balloon with the name that you have just given to this button will be displayed. In this case this name is “OFFICE WINDOWS 1”

When you arm and disarm the alarm you will not have to remind yourself every time what does this zone cover because it's description will be displayed.

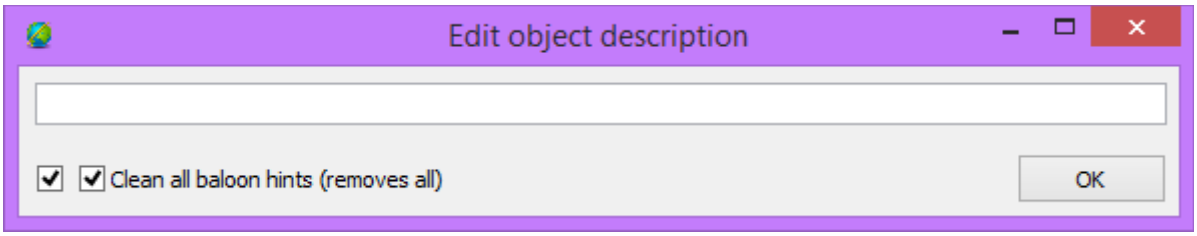


The balloon disappears after a couple of seconds or after you choose another element.

If you do not give any description to an element, the default description with the input number and LED number will be displayed in the balloon.

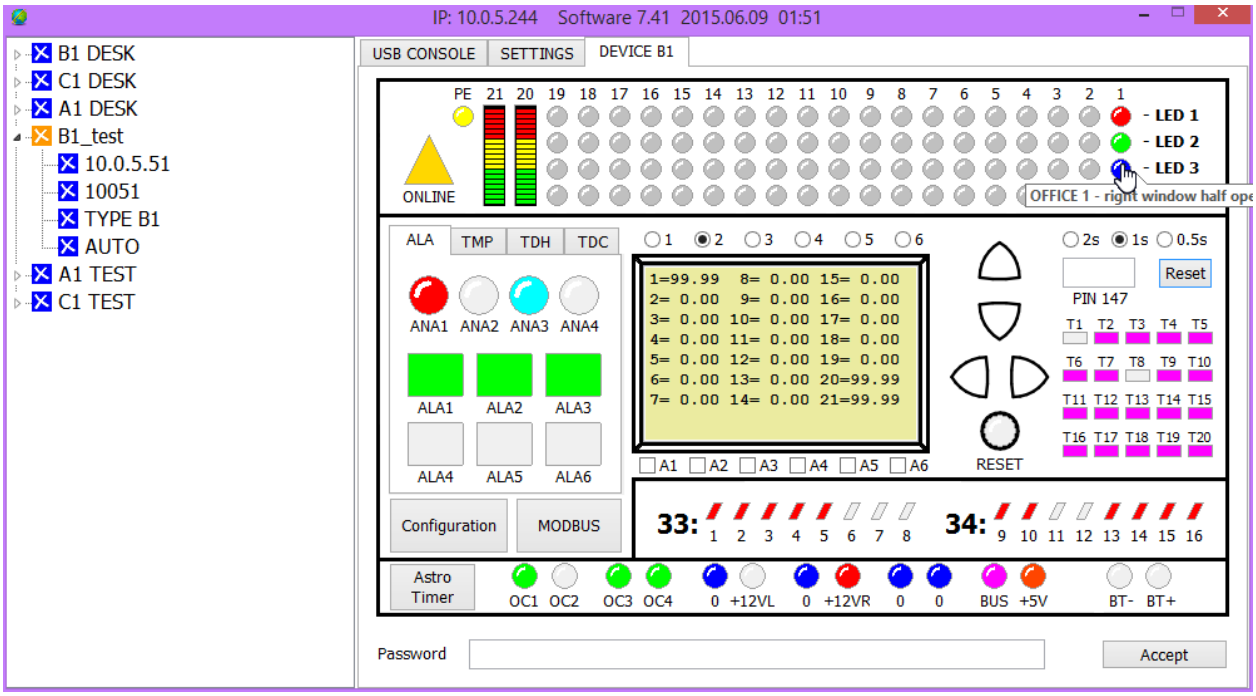


The assigned name can have any number of characters.



If you check the “Clean all balloon hints” box all names assigned earlier to any of the elements will be deleted. Check both boxes and press OK to confirm choosing this option. Having to check both boxes should prevent accidental data deletion.

When assigning names to other elements e.g. individual sensors, follow the same procedure as for the alarm zones.



Descriptions are saved in a '*.xml' file located in the same folder as the software.

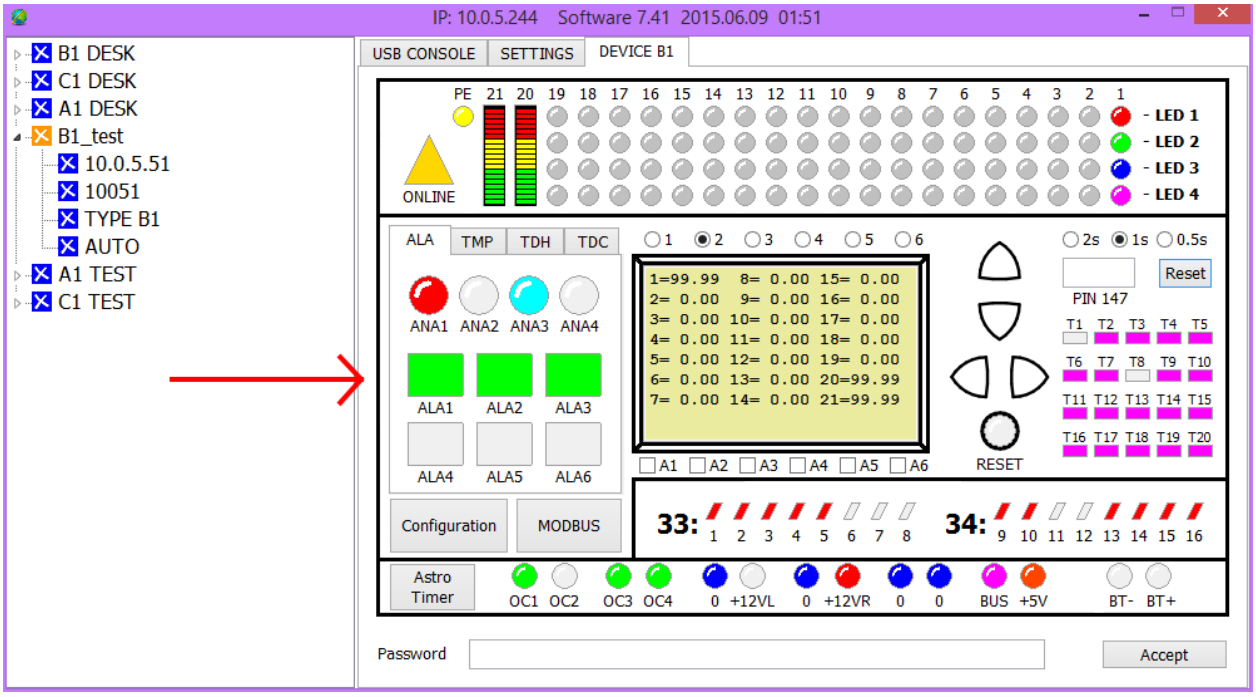
The 'myrelays.xml' file can be copied to the internal memory card main folder on a mobile device or to the software folder or another computer so that you do not have repeat assigning the names in other copies of the software.

If your Android mobile device does not have a built-in memory card then you should copy this file to an external SD card. If the device has both of those memory cards then always copy the file to the built-in one.

When updating the software remember to keep the 'myrelays.xml' file as you can simply copy and use it.

15. ARMING AND DISARMING ALARM ZONES, DELETING ALARMS

Buttons used to arm and disarm the alarms are placed in the main window of the program.



On the left there are the alarm zone status buttons 1 to 6.

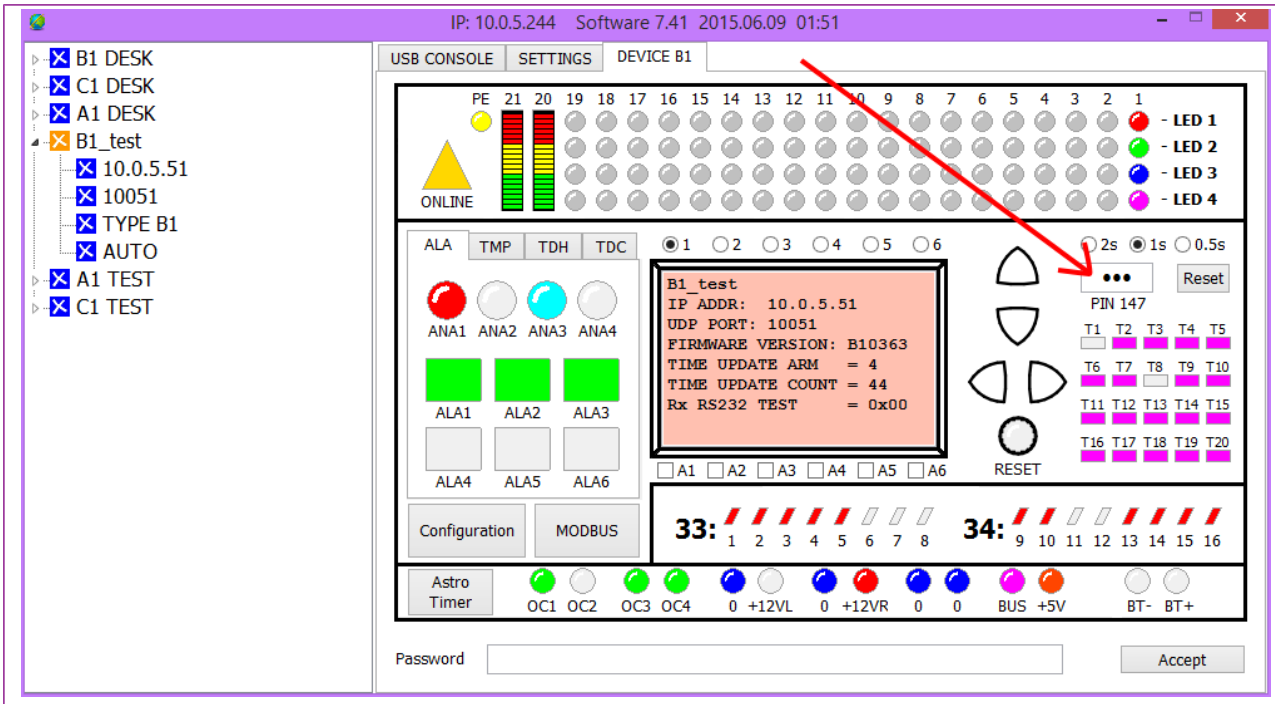
The color of the button depends on it's current status.

Alarm zones ALARM1 – ALARM6:

- gray – the zone is not active, the alarm for this zone is not armed
- green – the zone is active, the alarm is armed
- red – the alarm in this zone was triggered
- dark blue – line sabotage alarm
- yellow – the zone armed itself after an alarm occurred
- light purple – the zone armed itself after line sabotage alarm ocurred

To arm, disarm or delete an alarm **you first need to enter the 147 PIN code** in the field above the T1 – T20 timers. You simply need to enter the number, you do not need to confirm it.

The display will change color to pink. The ability to arm, disarm or delete the alarm, manually switch inputs on and off, reset the device using the RESET button in the software, will be unlocked.



The PIN code is essential to ensure that you do not accidentally press anything in the software. Above the PIN code you can choose how often the program communicates with the device to refresh the readings in the software. 1s is 1 second.

15.1. Arming an alarm zone

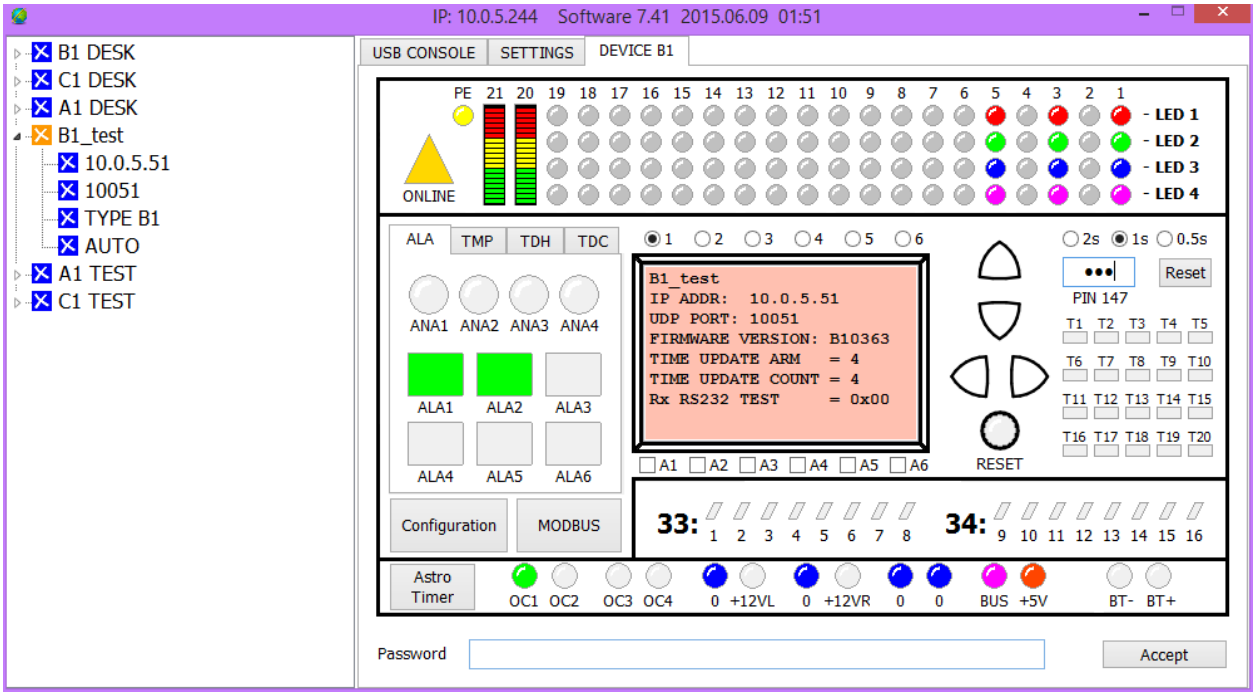
Example:

Reed switches from offices 1 and 2 were connected to inputs 1 and 3.
Inputs 1 and 3 were then assigned to ALARM ZONE 1 named WINDOWS IN OFFICES.

The reed switches of the winter garden exterior and interior doors were connected to input 5, LED 3 and LED 4.
Input 5 was assigned to alarm zone 2 named WINTER GARDEN DOORS.

Then, both alarms zones were armed remembering that the 147 PIN code needs to be entered first.

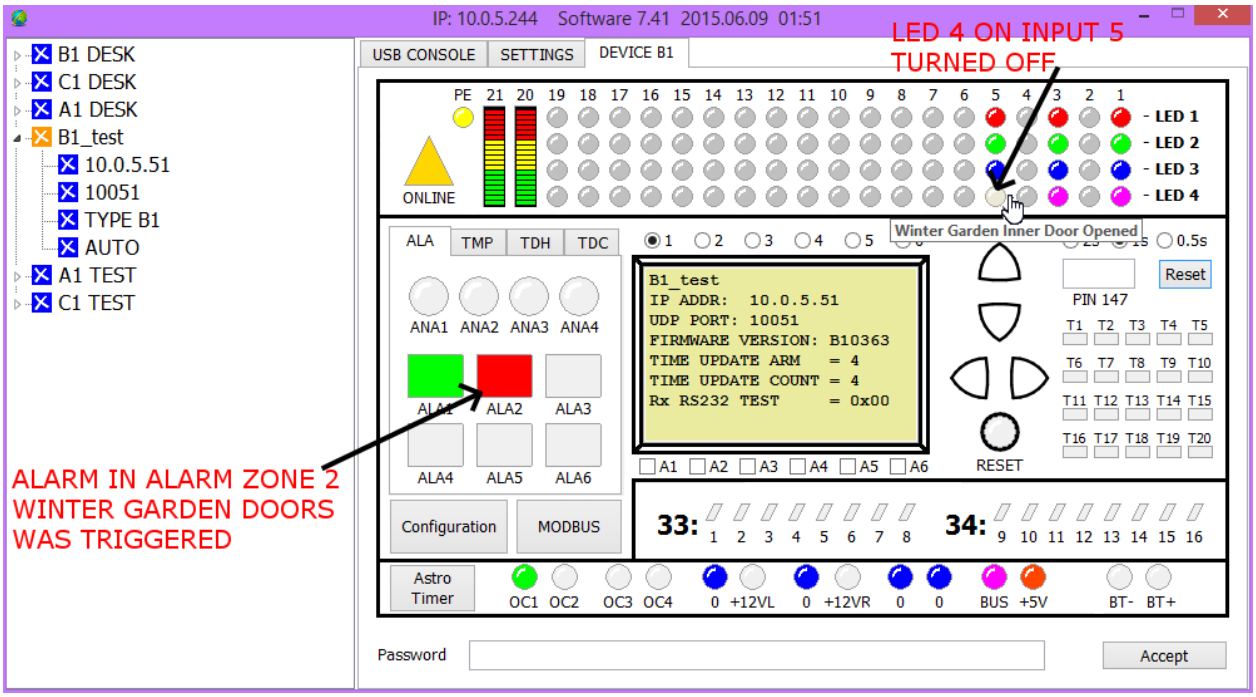
Armed zone buttons change color to green.



From now on, half-opening or opening any of the connected windows or opening the doors will trigger the alarm.

Now:

The winter gardens inner doors were opened.



Alarm zone button 2 changed color to red which means that the alarm in zone 2 was triggered. LED 4 on input 5, to which the reed switch in the winter garden inner door is connected, went off which means the door was opened.

You can see in what zone and where exactly an event had occurred that triggered the alarm.

15.2. Deleting an alarm in an alarm zone

ALARMS IN ALARM ZONES 1-6 DO NOT DISAPPEAR TOGETHER WITH THE CAUSE OF THE ALARM.

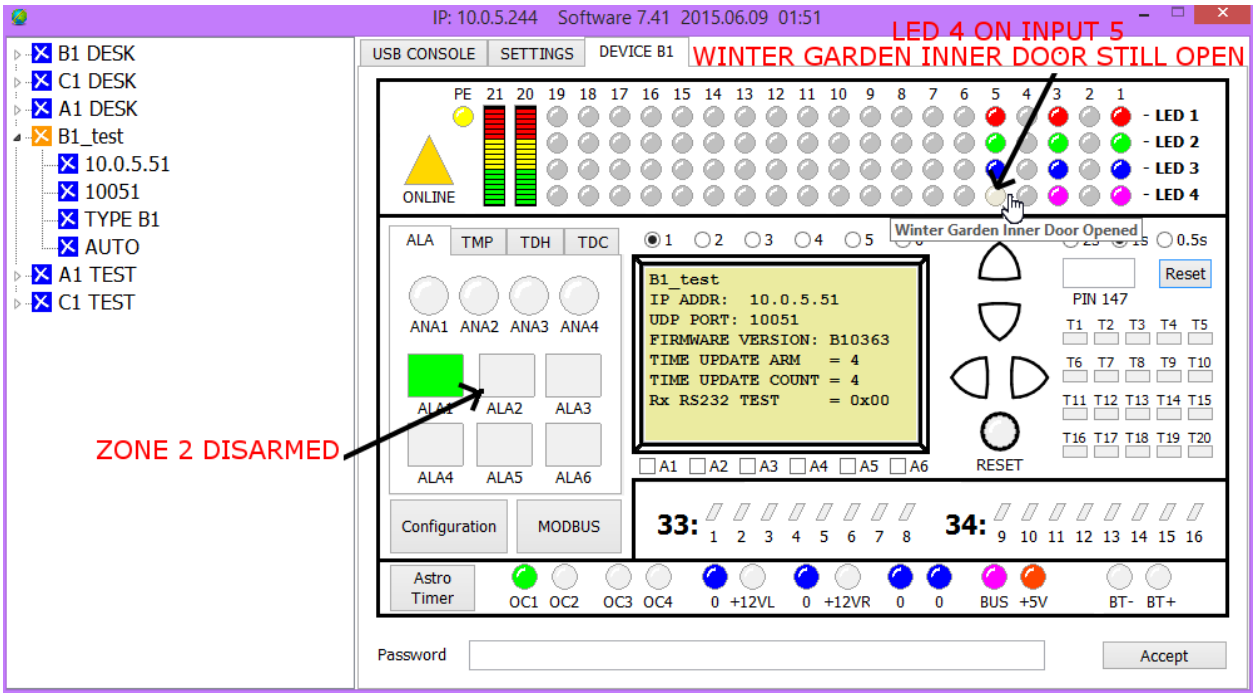
THEY NEED TO BE DELETED OR YOU NEED TO SET AUTOMATIC RE-ARMING.

You delete an alarm in an alarm zone by clicking it's alarm zone button when it's red. Of course, remember to first enter the 147 PIN code.

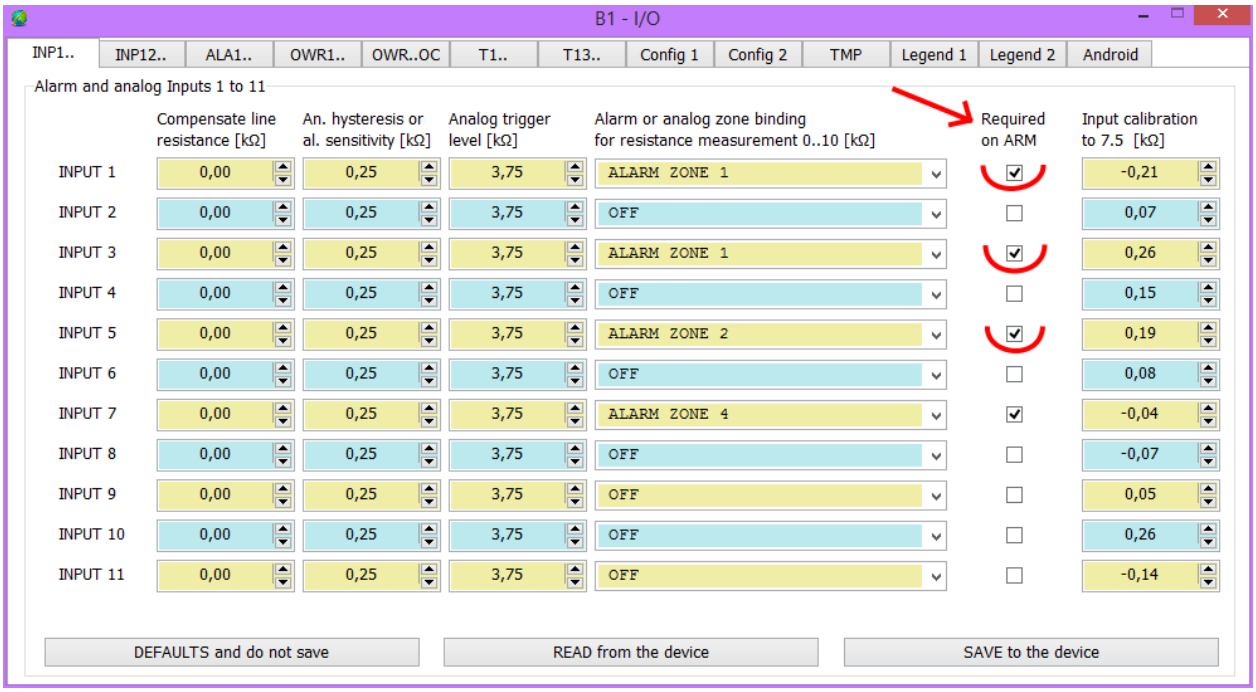
You do the same if the alarm was triggered by the Line Sabotage Guard function. That kind of alarm will be shown in blue – differently from a normal alarm. If the alarm zone button changes back to blue after you switch off the alarm it means that the cause of the alarm has not disappeared and you need to check the circuits connected to that alarm zone.

The button will change color to gray meaning the zone is now disarmed.

Because the door are still open, LED 4 on input 5 is still off.

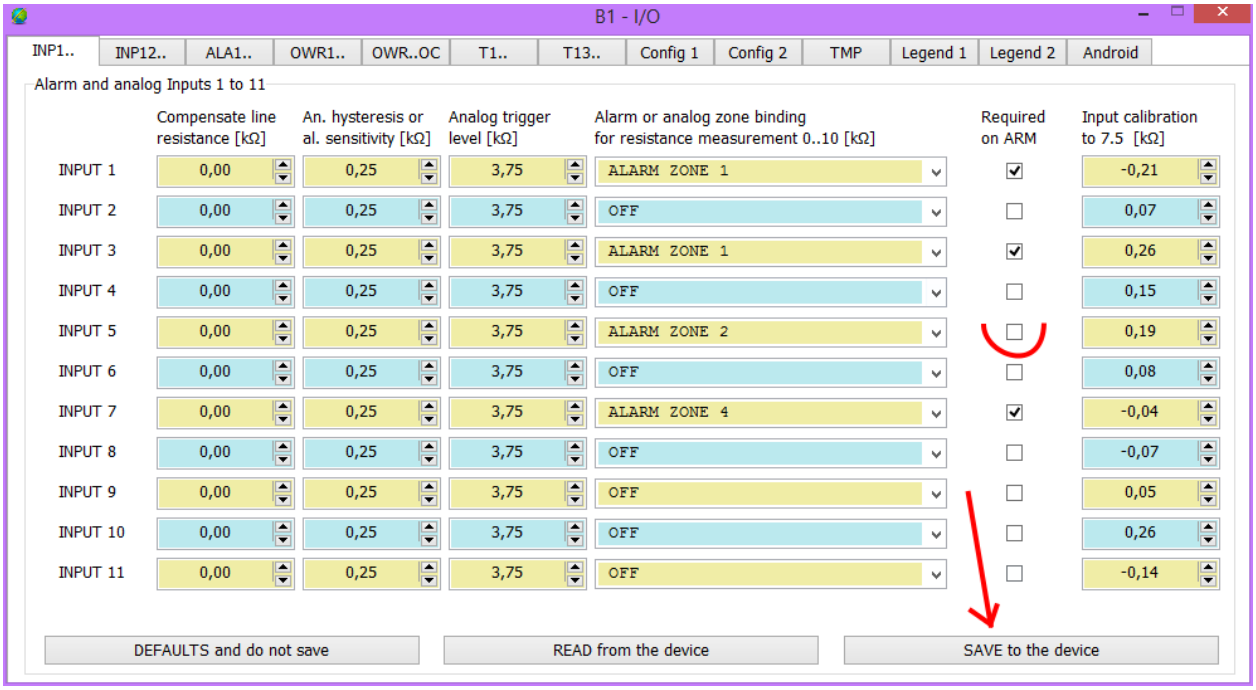


In the alarm input configuration window, the 'Require to ARM' option was chosen earlier.


B1 - I/O
INP1..
INP12..
ALA1..
OWR1..
OWR..OC
T1..
T13..
Config 1
Config 2
TMP
Legend 1
Legend 2
Android
Alarm and analog Inputs 1 to 11
Compensate line resistance [kΩ]
An. hysteresis or al. sensitivity [kΩ]
Analog trigger level [kΩ]
Alarm or analog zone binding for resistance measurement 0..10 [kΩ]
Required on ARM
Input calibration to 7.5 [kΩ]
INPUT 1 0,00 0,25 3,75 ALARM ZONE 1 -0,21
INPUT 2 0,00 0,25 3,75 OFF 0,07
INPUT 3 0,00 0,25 3,75 ALARM ZONE 1 0,26
INPUT 4 0,00 0,25 3,75 OFF 0,15
INPUT 5 0,00 0,25 3,75 ALARM ZONE 2 0,19
INPUT 6 0,00 0,25 3,75 OFF 0,08
INPUT 7 0,00 0,25 3,75 ALARM ZONE 4 -0,04
INPUT 8 0,00 0,25 3,75 OFF -0,07
INPUT 9 0,00 0,25 3,75 OFF 0,05
INPUT 10 0,00 0,25 3,75 OFF 0,26
INPUT 11 0,00 0,25 3,75 OFF -0,14
DEFAULTS and do not save
READ from the device
SAVE to the device

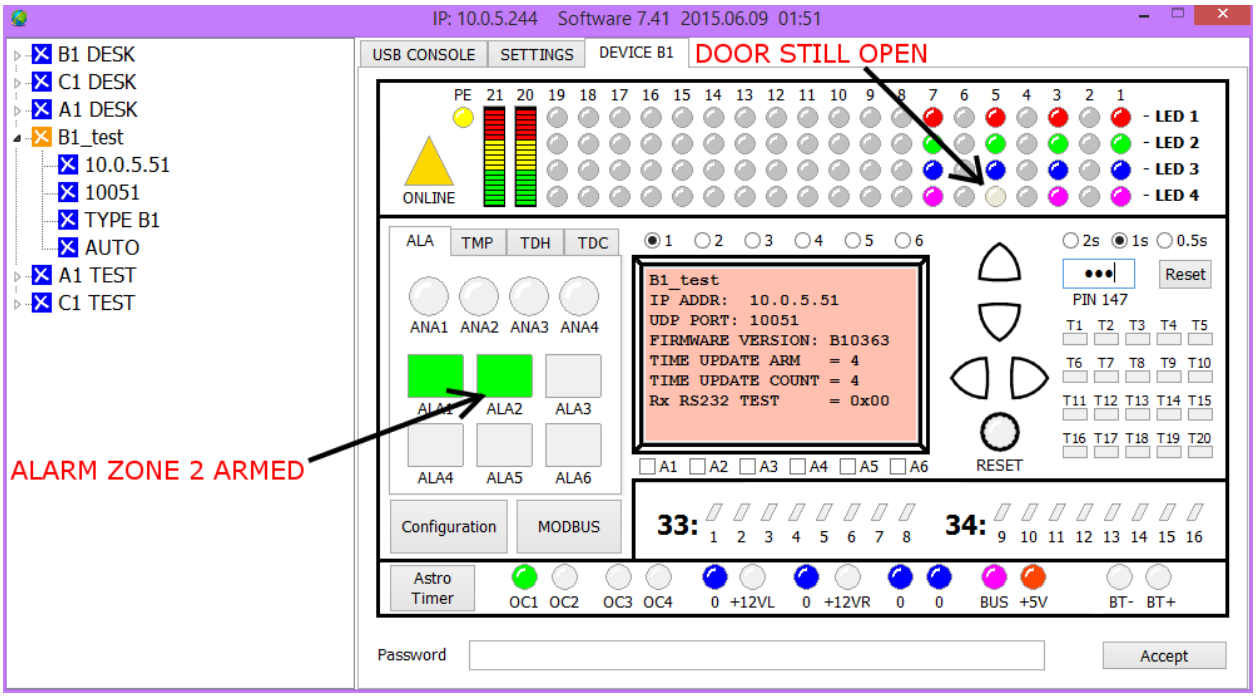
This means the alarm zone cannot be armed again until the door is closed. You can click the alarm button as long as you want but it will bring no results.

To arm the alarm you must either close the door or uncheck the 'Require to ARM' checkbox for input 5.

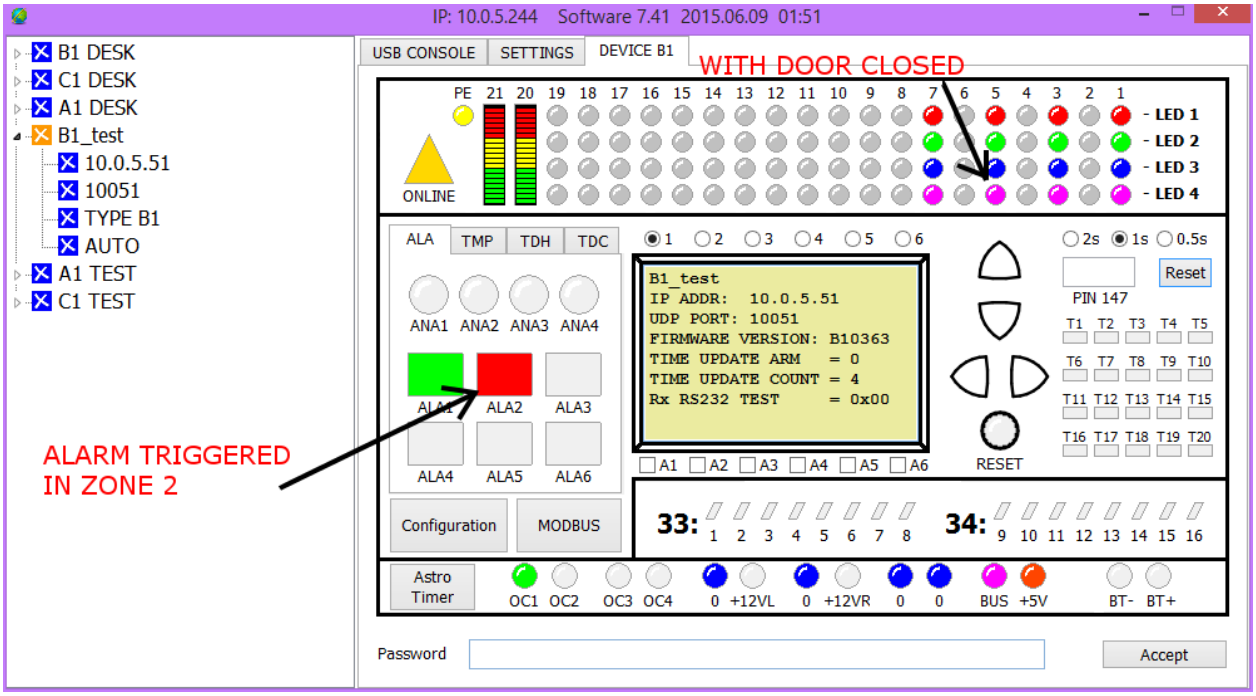

B1 - I/O
INP1..
INP12..
ALA1..
OWR1..
OWR..OC
T1..
T13..
Config 1
Config 2
TMP
Legend 1
Legend 2
Android
Alarm and analog Inputs 1 to 11
Compensate line resistance [kΩ]
An. hysteresis or al. sensitivity [kΩ]
Analog trigger level [kΩ]
Alarm or analog zone binding for resistance measurement 0..10 [kΩ]
Required on ARM
Input calibration to 7.5 [kΩ]
INPUT 1 0,00 0,25 3,75 ALARM ZONE 1 -0,21
INPUT 2 0,00 0,25 3,75 OFF 0,07
INPUT 3 0,00 0,25 3,75 ALARM ZONE 1 0,26
INPUT 4 0,00 0,25 3,75 OFF 0,15
INPUT 5 0,00 0,25 3,75 ALARM ZONE 2 0,19
INPUT 6 0,00 0,25 3,75 OFF 0,08
INPUT 7 0,00 0,25 3,75 ALARM ZONE 4 -0,04
INPUT 8 0,00 0,25 3,75 OFF -0,07
INPUT 9 0,00 0,25 3,75 OFF 0,05
INPUT 10 0,00 0,25 3,75 OFF 0,26
INPUT 11 0,00 0,25 3,75 OFF -0,14
DEFAULTS and do not save
READ from the device
SAVE to the device

After unchecking the checkbox and saving the settings, click the alarm zone 2 button.

The alarm is now armed even though the door are still open.



Remember though that in this situation closing the door will trigger the alarm!



The ability to arm the alarm when windows are opened or half-opened can be useful when you want to leave the windows open during the night or when there was a sensor malfunction that you cannot fix immediately.

15.3. Disarming an alarm zone

To disarm an armed alarm zone (the alarm zone button is green) you simply need to enter the 147 PIN code and click the alarm zone button. The button will change color to gray and the zone will be deactivated, the alarm will be disarmed.

15.4. Rearming alarm zones after time

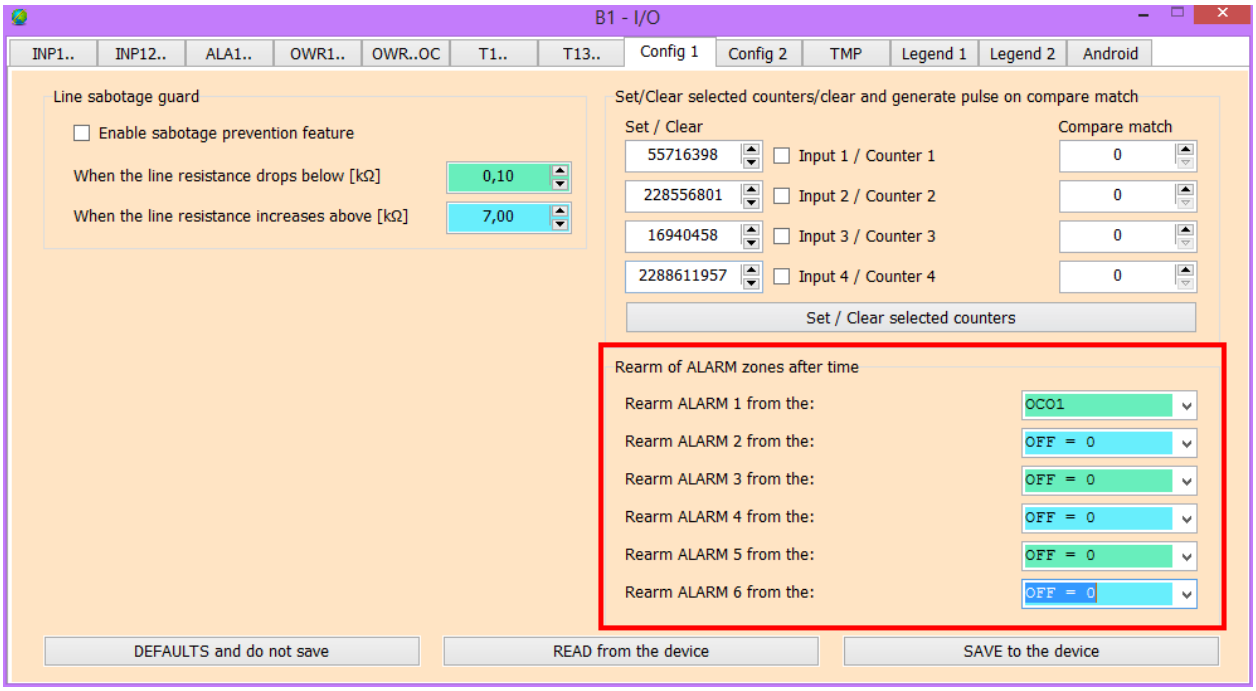
You can set up the device to automatically rearm a zone after a certain amount of time has passed after an alarm occurred.

Go to the Config 1 tab.

Choose one of the – Rearm ALARM from the: – options

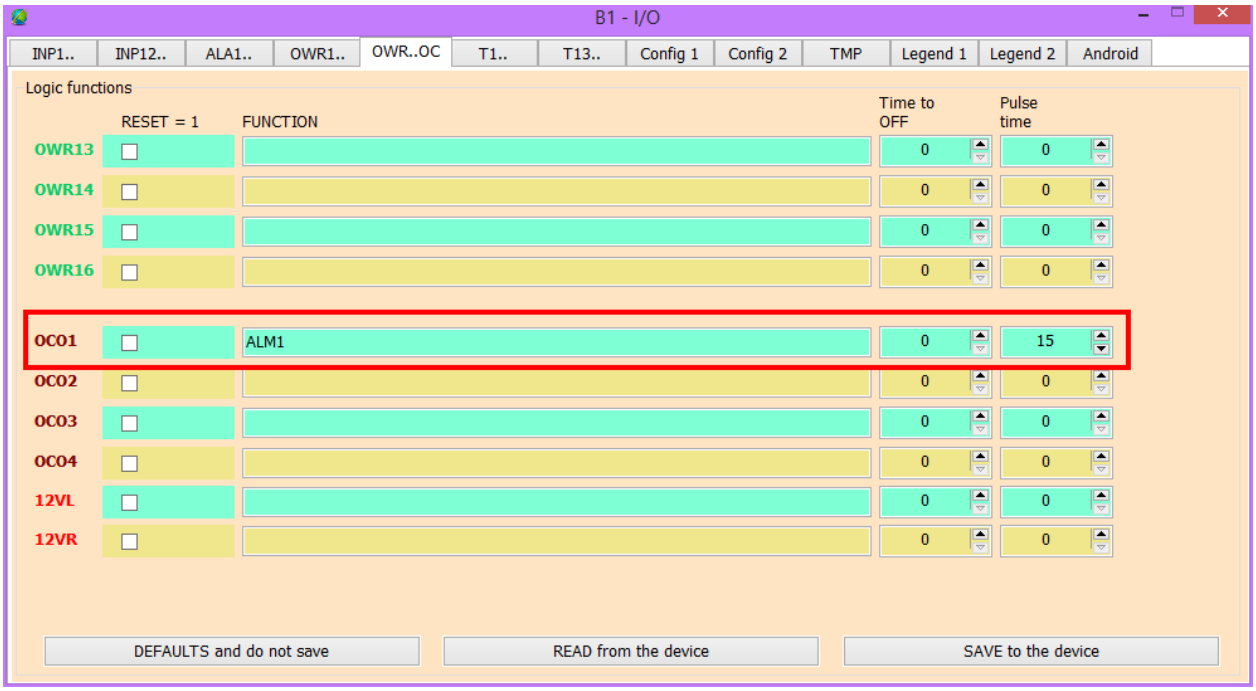
Next, from the list pick one of the variables which has a counter and can be used to rearm an alarm zone where an alarm occurred.

Here we picked OCO1 – open collector output 1.



Save the settings after picking the variable.

Go to the OC outputs settings tab.



In this tab you can assign an equation or condition that will activate chosen outputs.

For **OCO1** enter **ALM1** – alarm from zone 1.

The list of variables available is shown in the Legend1 tab.

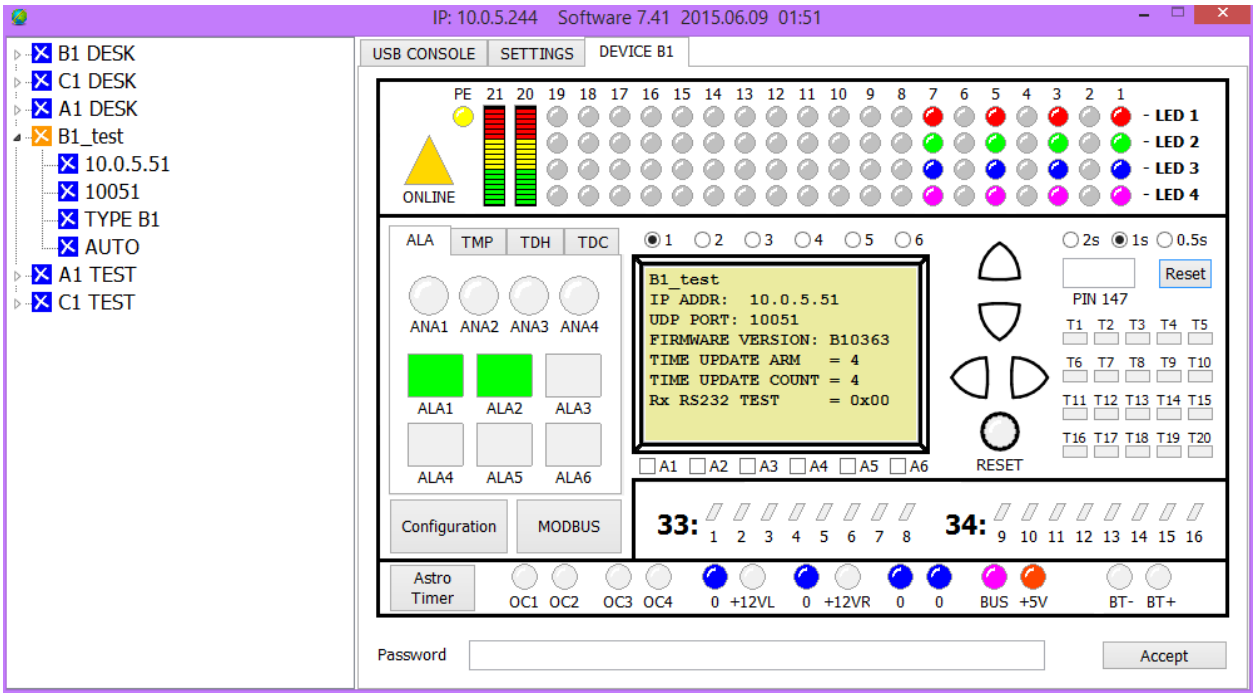
Enter the period of time (in seconds) after which you want the alarm to rearm itself in the Pulse time field.

We entered 15 seconds.

The most you can enter is 18 hours.

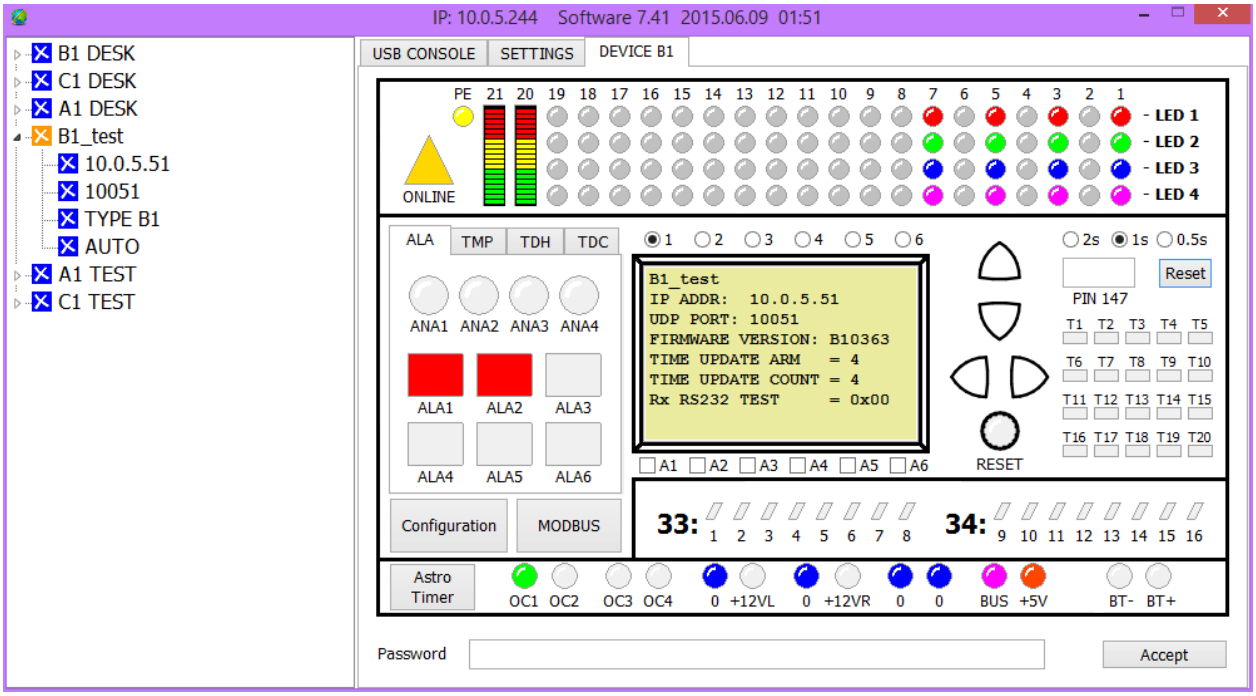
Save the settings.

Arm Alarm zone 1:

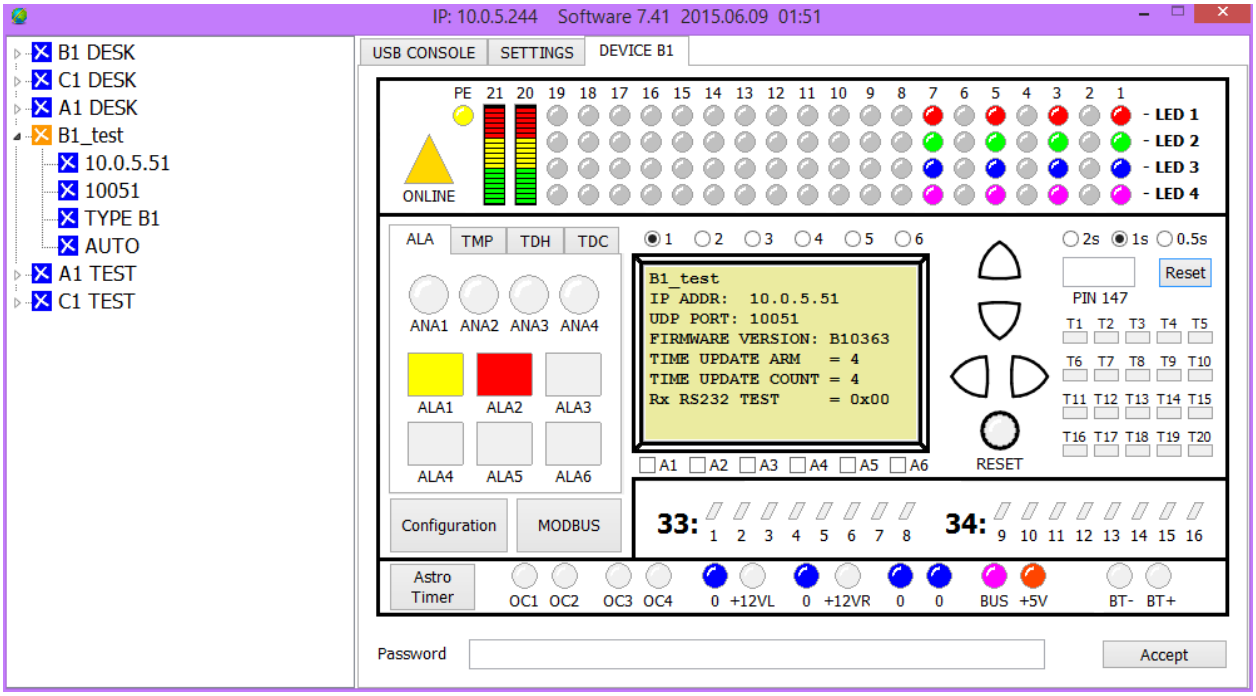


After an event in zone 1 had occurred, the alarm was activated – the ALA1 light changed to red.

The OCO1 input was also activated – the condition for it's activation, an alarm in zone 1, was fulfilled.



After 15 seconds (as we set earlier) the OCO1 output will be deactivated and zone 1 will be armed again (because the OCO1 variable was chosen for the condition to rearm)



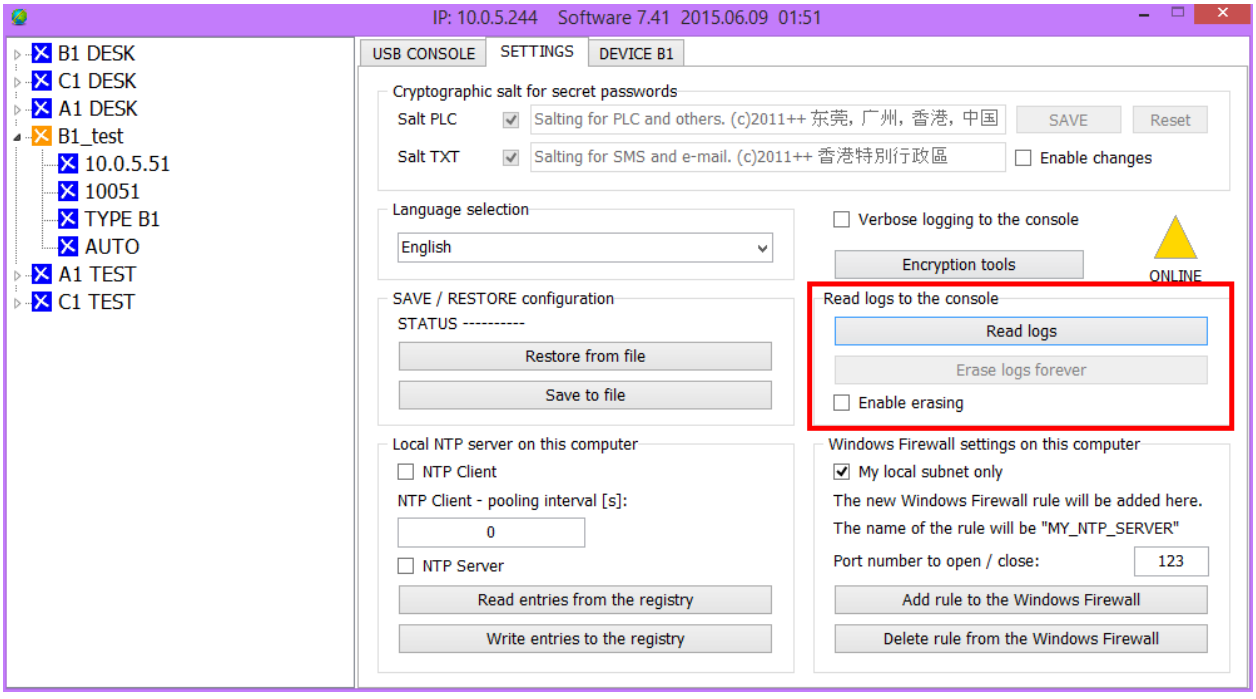
The Alarm Zone 1 lamp will change to yellow – this color indicates that an alarm had occurred before the zone rearmed itself.

Zone 1 is armed.

Go to the **SETTINGS** tab.

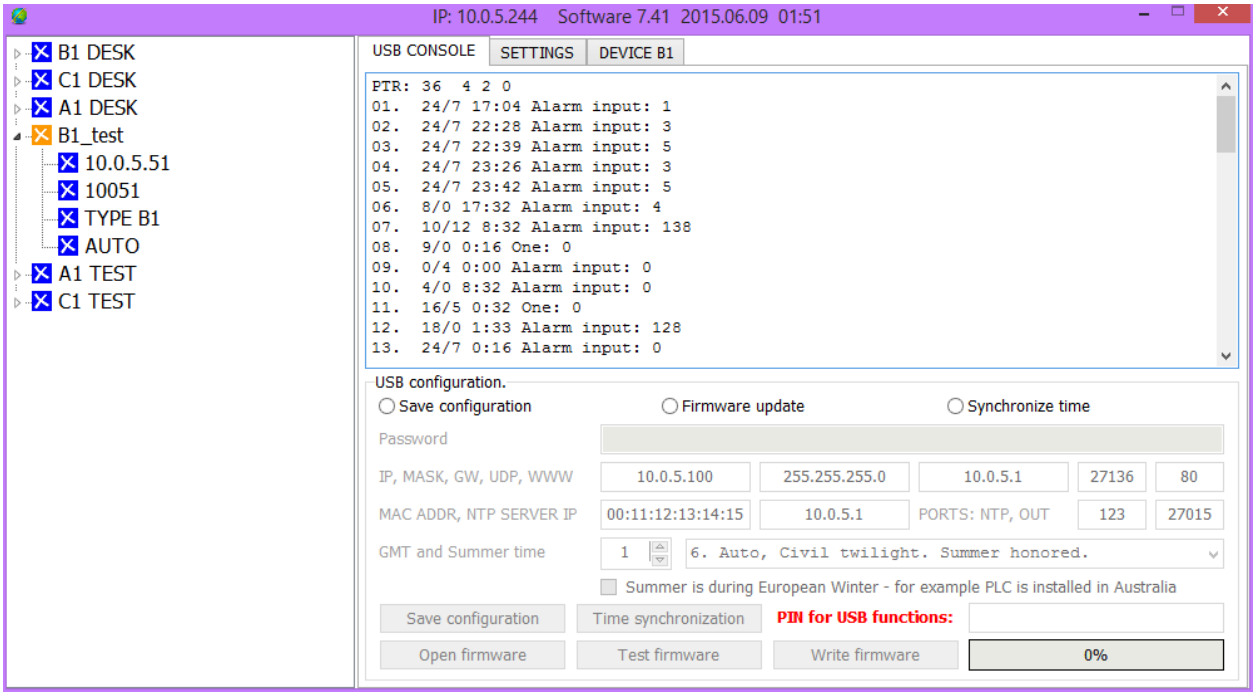
Find the **Read logs to the console** field.

Click the **Read logs** button.



Go to the **USB CONSOLE** tab

A list of the last 59 alarm with their dates, times and inputs will be shown.

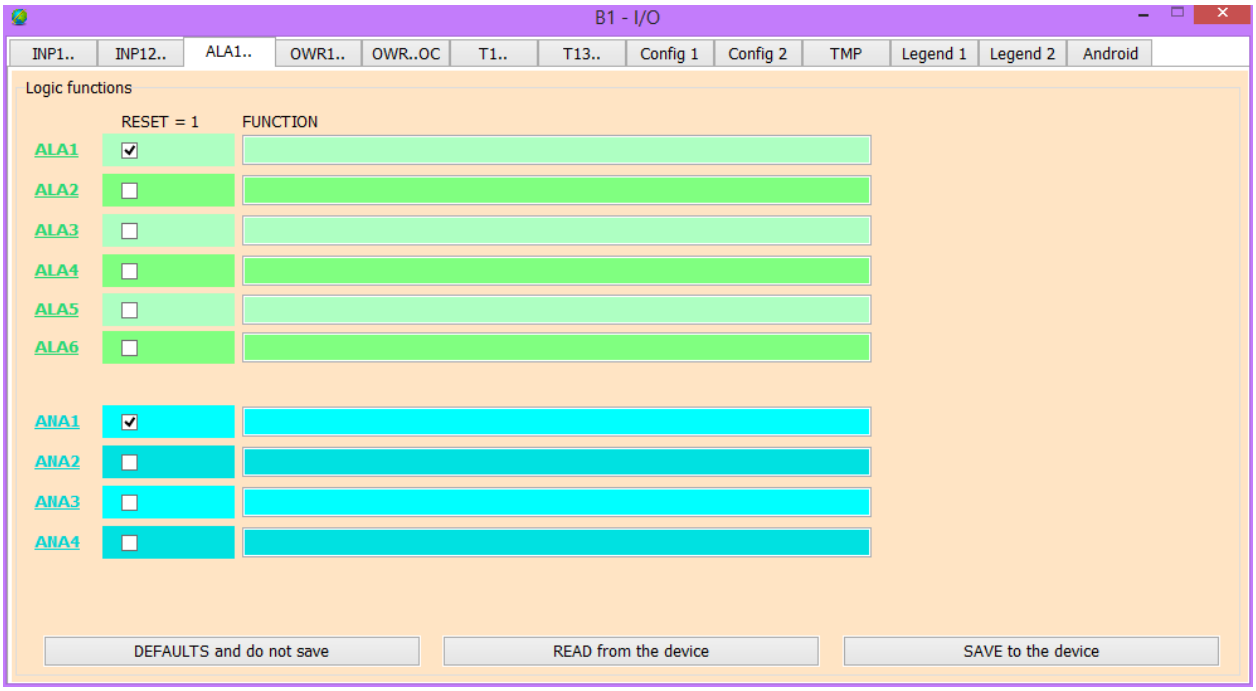


15.5. Automatic rearming of alarm zones after reset or power return

In the **third** tab there is a function which allows automatic rearming of chosen alarm zones after a reset of the device or a power supply return. Normally in those cases, alarm zones will be inactive until you switch them on yourself or they are activated by some function.

For the function to be active you need to mark the zones you want it to use it for and save the changes. After the next reset or power return the chosen zones will rearm themselves automatically.

Sometimes there is a need of resetting the device and this function is designed to save the user's time by eliminating the need to restore the previous settings manually.

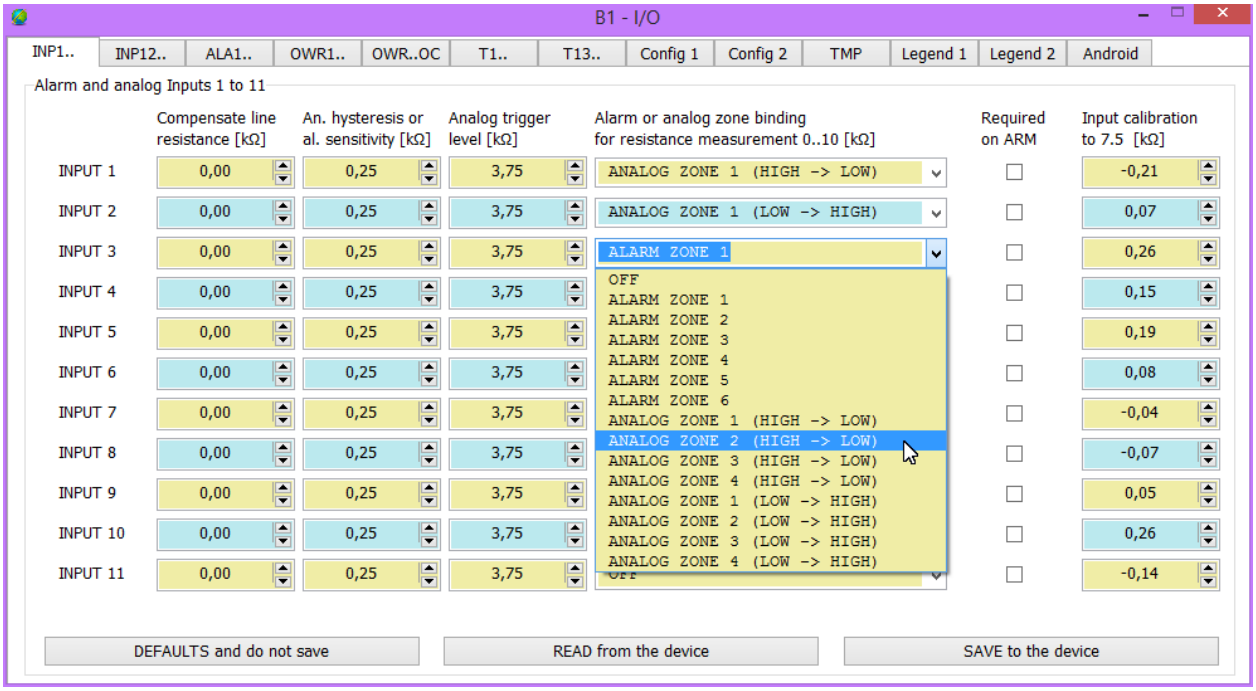


16. ANALOG INPUT CONFIGURATION

You can configure any input to be a measuring input. You can measure resistance between this input and ground.
On the basis of the measurement you can react to a given value being exceeded by setting the measurement mode, trigger level and hysteresis sensitivity.

For example, you can configure a simple regulator with hysteresis or a sensor co-working with the environment on the basis of the measured resistance.

You can pick from two operation modes for an analog input:


B1 - I/O
INP1..
INP12..
ALA1..
OWR1..
OWR..OC
T1..
T13..
Config 1
Config 2
TMP
Legend 1
Legend 2
Android
Alarm and analog Inputs 1 to 11
Compensate line resistance [kΩ]
An. hysteresis or al. sensitivity [kΩ]
Analog trigger level [kΩ]
Alarm or analog zone binding for resistance measurement 0..10 [kΩ]
Required on ARM
Input calibration to 7.5 [kΩ]
INPUT 1 0,00 0,25 3,75 ANALOG ZONE 1 (HIGH -> LOW) -0,21
INPUT 2 0,00 0,25 3,75 ANALOG ZONE 1 (LOW -> HIGH) 0,07
INPUT 3 0,00 0,25 3,75 ALARM ZONE 1 0,26
INPUT 4 0,00 0,25 3,75 0,15
INPUT 5 0,00 0,25 3,75 0,19
INPUT 6 0,00 0,25 3,75 0,08
INPUT 7 0,00 0,25 3,75 -0,04
INPUT 8 0,00 0,25 3,75 -0,07
INPUT 9 0,00 0,25 3,75 0,05
INPUT 10 0,00 0,25 3,75 0,26
INPUT 11 0,00 0,25 3,75 -0,14
OFF
ALARM ZONE 1
ALARM ZONE 2
ALARM ZONE 3
ALARM ZONE 4
ALARM ZONE 5
ALARM ZONE 6
ANALOG ZONE 1 (HIGH -> LOW)
ANALOG ZONE 2 (HIGH -> LOW)
ANALOG ZONE 3 (HIGH -> LOW)
ANALOG ZONE 4 (HIGH -> LOW)
ANALOG ZONE 1 (LOW -> HIGH)
ANALOG ZONE 2 (LOW -> HIGH)
ANALOG ZONE 3 (LOW -> HIGH)
ANALOG ZONE 4 (LOW -> HIGH)
DEFAULTS and do not save
READ from the device
SAVE to the device

Decreasing resistance (**High to Low**). The lower value (e.g. 3kΩ) will be the trigger level and the higher value (e.g. 8kΩ) will be the hysteresis level.

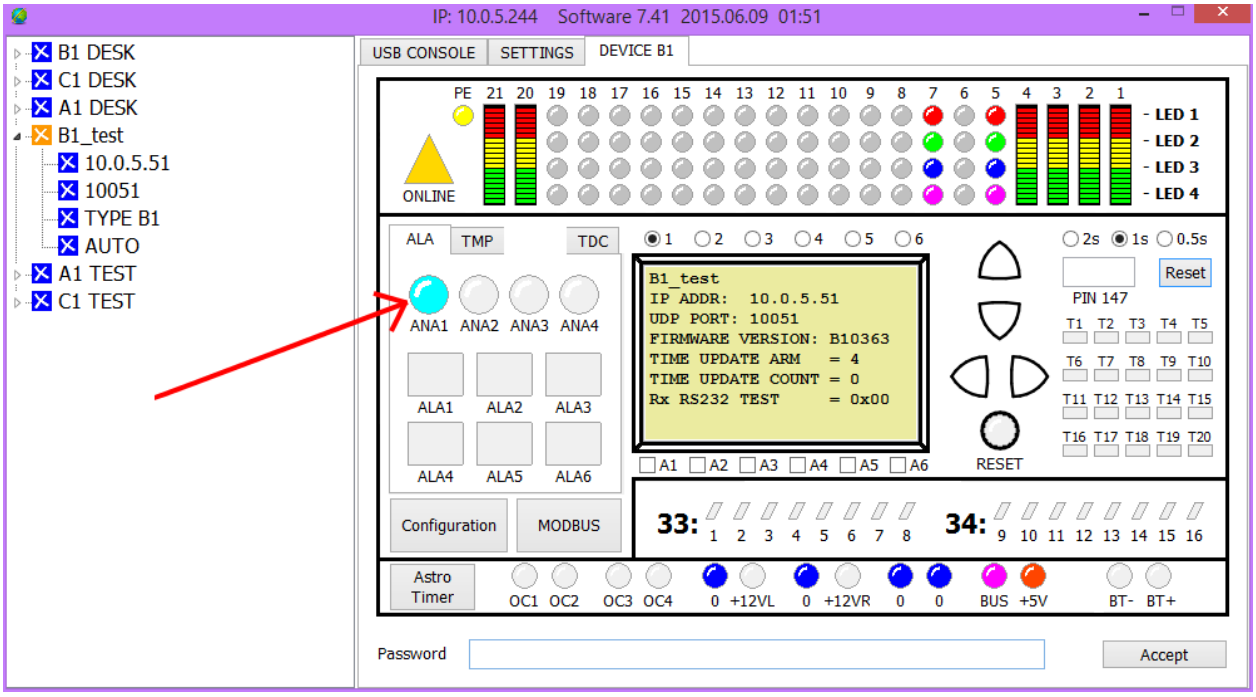
Increasing resistance (**Low to High**). The higher value (e.g. 8kΩ) will be the trigger level and the lower value (e.g. 3kΩ) will be the hysteresis level.

To an input set as analog you can connect a photoresistor or simply put a wire in a place that could be flooded and wait for resistance to change from infinite (shown as 99.99) to a level that is measurable by the input.

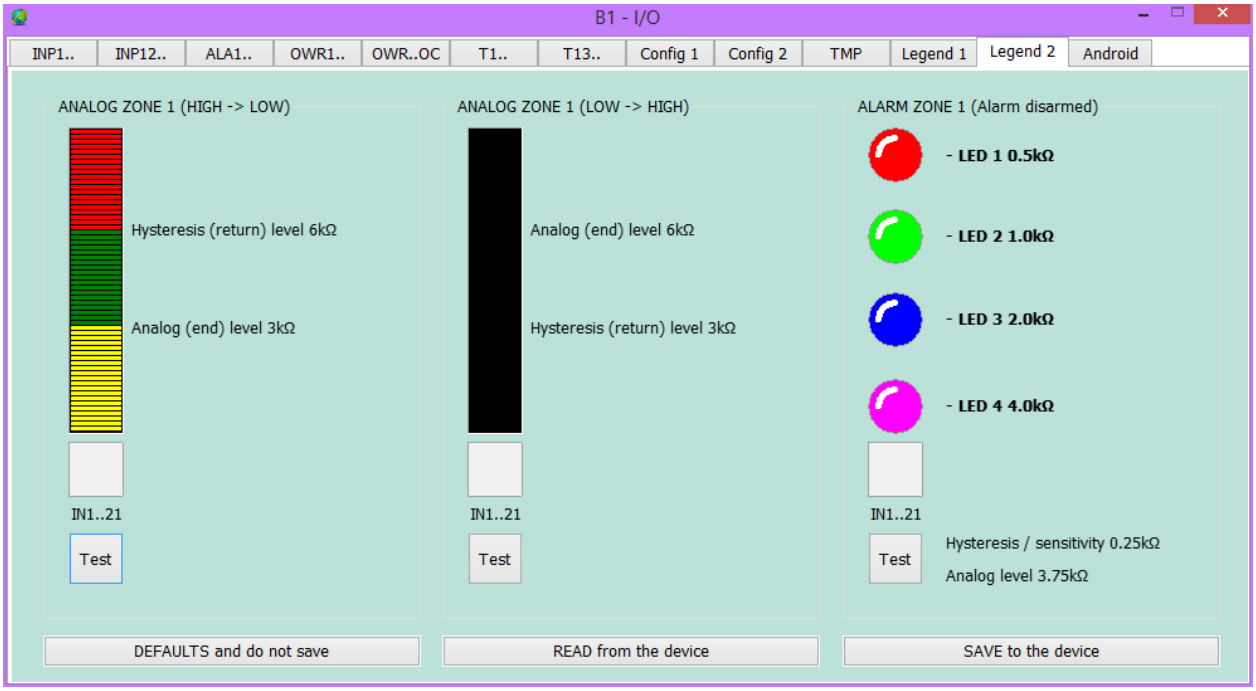
It is advised to install any high value resistor, eg. 22kΩ, 33kΩ or 47kΩ, between the flooding sensor input and the ground so the line does not stay open.

You can use the analog mode in any other situation if only you can measure the resistance.
The result of crossing the trigger level and hysteresis is directed to a variable corresponding to the input – IN1-IN21 – on the condition that the analog zone is active.
To activate an analog zone you must click one of the ANA1 – ANA4 lights in the main window of the software.
First you need to enter the **147** PIN code.

The light will change to blue – this indicates the analog zone is active.



The rules for programming inputs set to analog mode are explained in the **Legend 2** tab.



Click TEST button to see the presentation.

17. 1-WIRE BUS

The device is equipped with a 1-Wire bus.

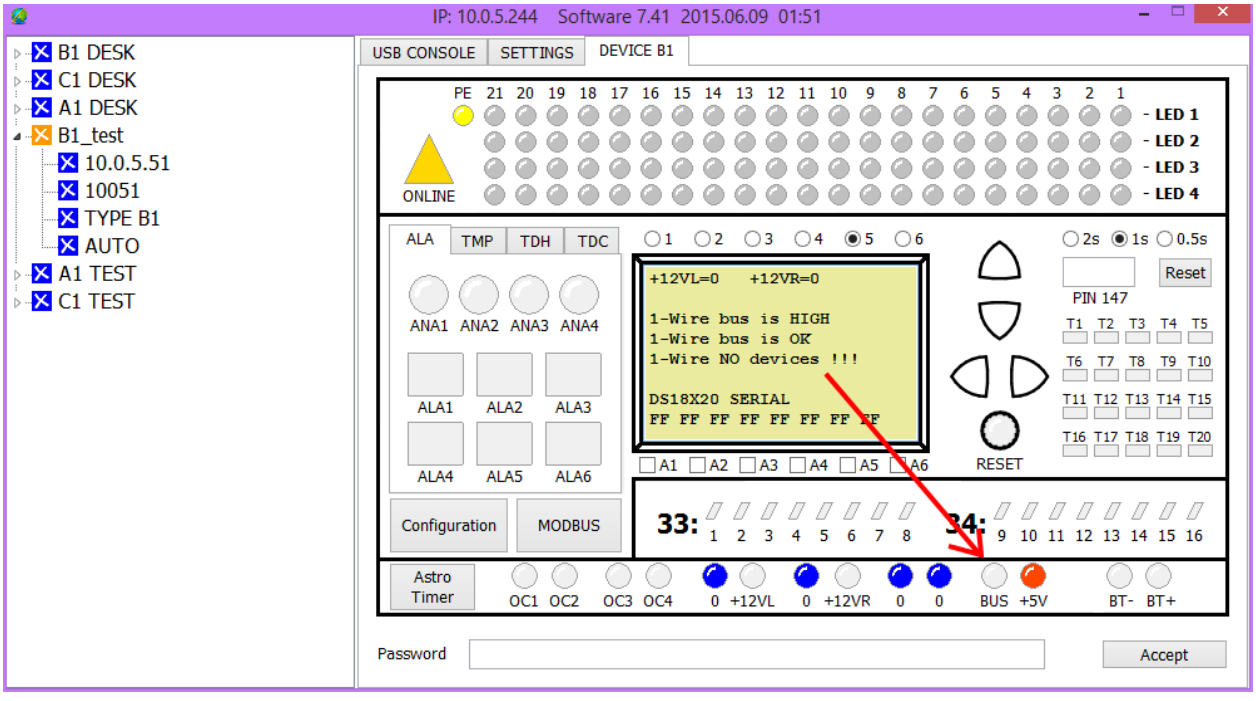
To the bus you can connect:

- up to 32 digital DALLAS thermometers
- up to 2 boards with eight relays based on the DS2408 IC
- up to 2 modules with inputs/outputs based on the DS 2408 IC
- one relay module and one input/output module.

The bus is sensitive to interruptions and you should make sure that the wiring is done accordingly to the guidelines at http://1wire.org.

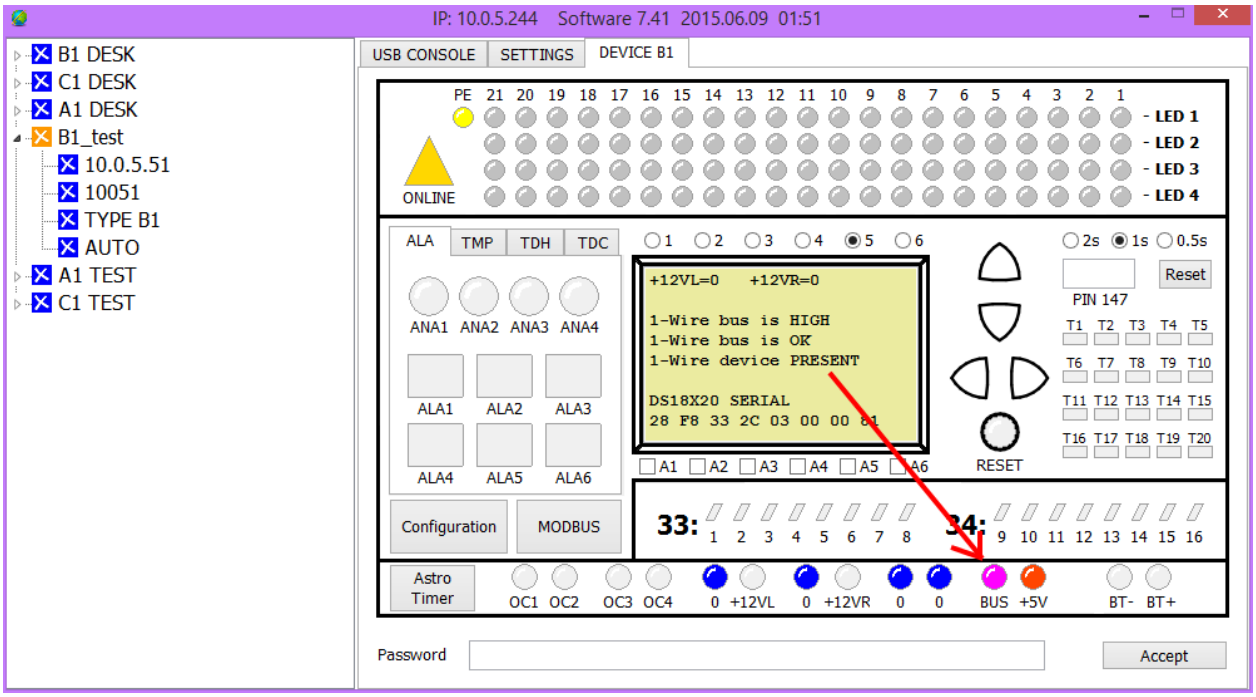
17.1. DALLAS THERMOMETERS

If no thermometer is connected to the bus then the information in 5th window on the display in the main window of the program looks like this:

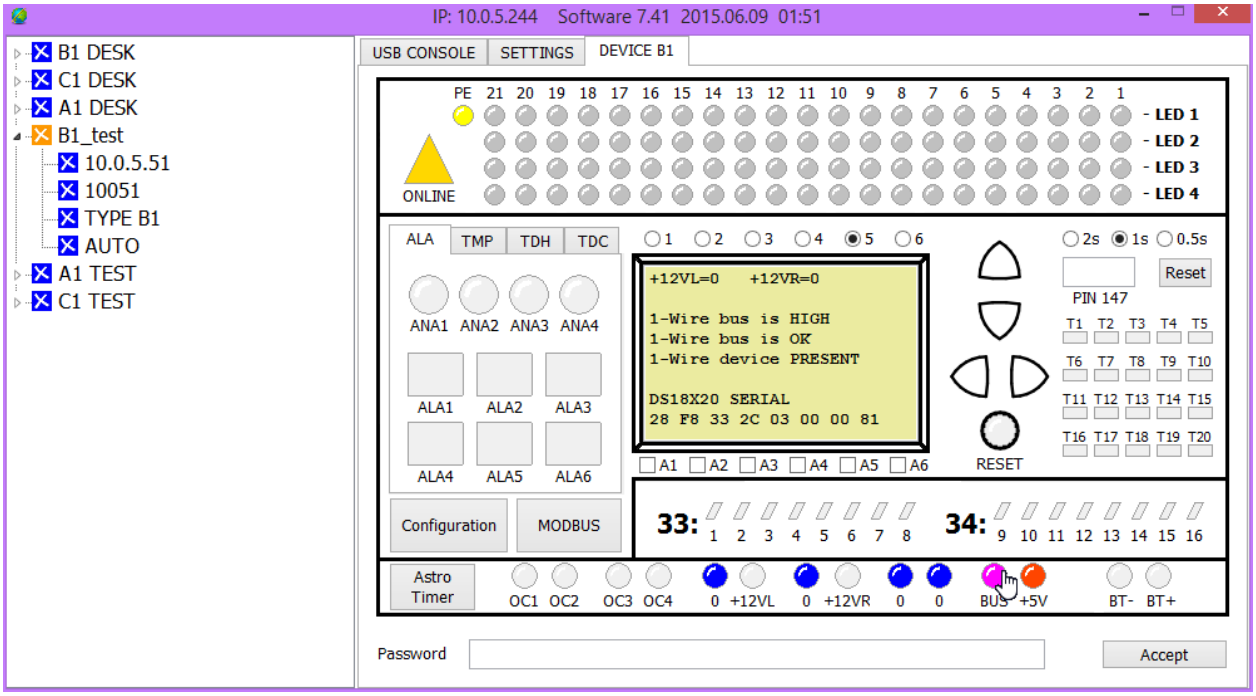


The light indicating that thermometers are connected **BUS** is off.

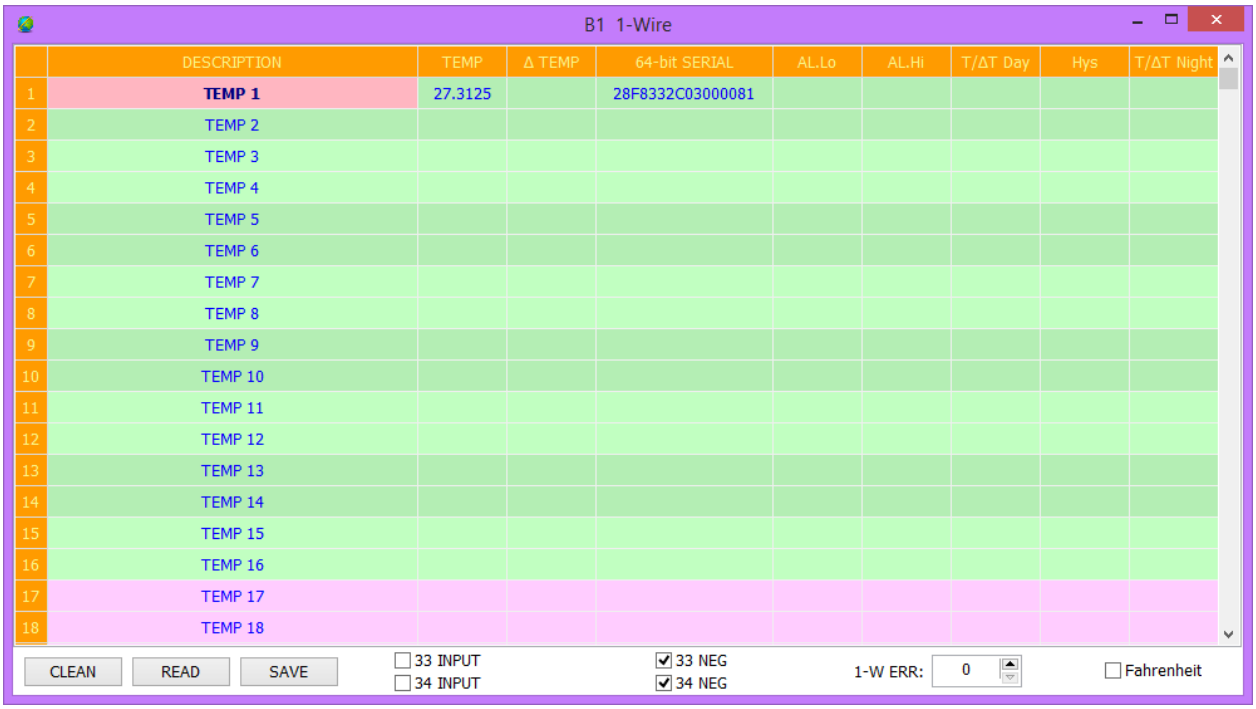
When you connect thermometers this light will change to pink and information about the thermometers will be shown in window 5 of the display.



You can enter the thermometer configuration window by double-clicking the BUS light – the mouse cursor will change to a hand when you put it on the light – see the pictures below:



The 1-Wire configuration window will pop out.



For the thermometers to be visible you first need to read and then enter in the program their serial numbers.

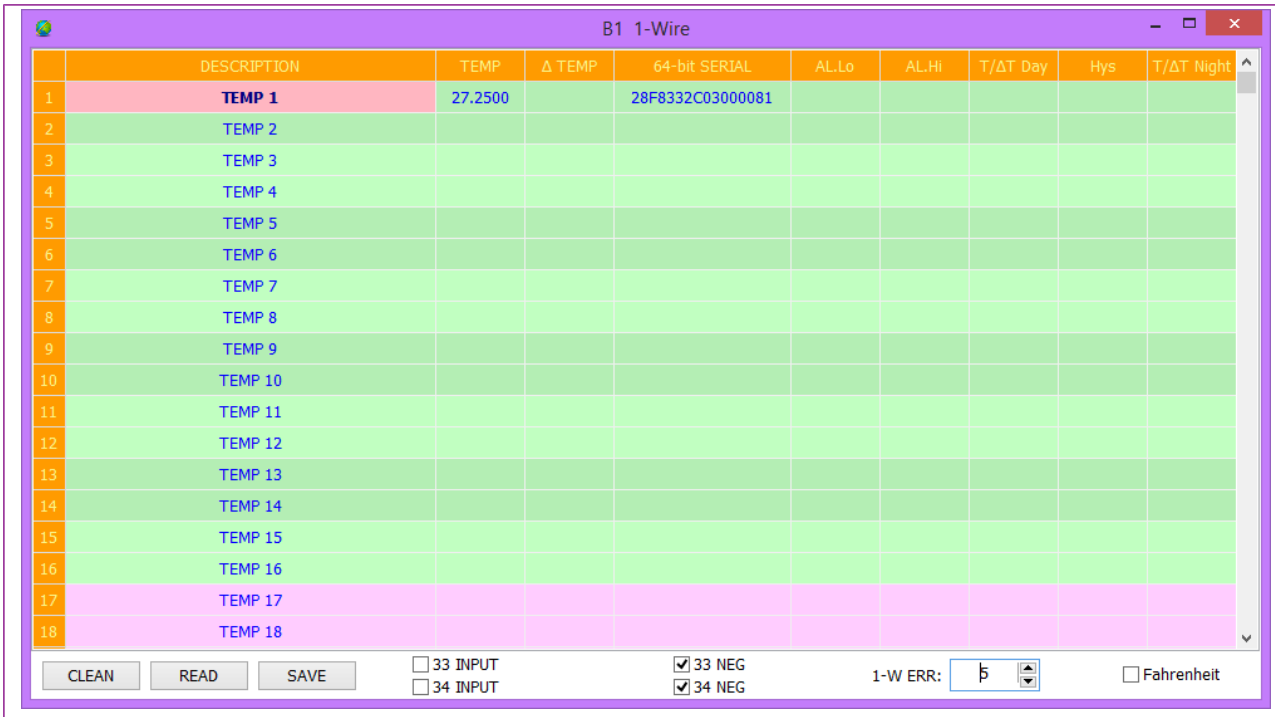
Smallest mistakes when entering the serial number will make it impossible to communicate with the thermometer.

The serial numbers of the devices connected to the 1-wire bus should be read by connecting them to the device one-by-one.

Only one device may be connected **at the moment you do the reading.**

Newest versions of the software:

'**1-W ERR**' field – used to set up 1-Wire data reading resistance to occurring transmission errors which are displayed by momentary thermometer disappearances. The 1-Wire bus itself is not very immune to interferences and the way wiring was installed is critical. All data regarding the 1-Wire bus can be seen at http://www.1wire.org.



These errors can be caused by:

1. Interferences from electrical machines
2. 1-Wire wiring being installed to close to electrical wiring
3. Wrong 1-Wire topology
4. Cords in use being too long
5. Use of wrong cords with too much capacity

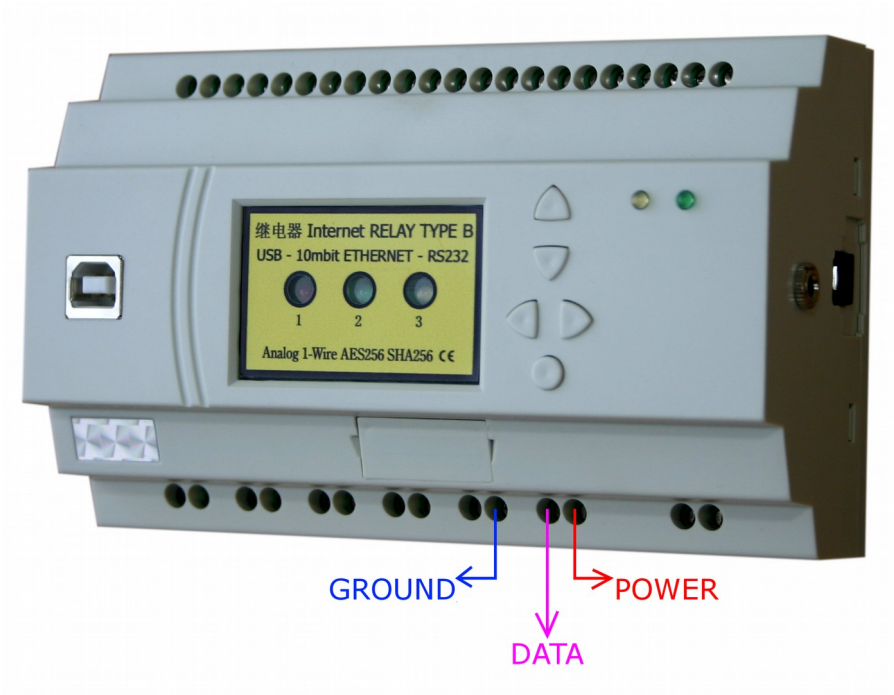
In the ‘1-W ERR’ field you set how many temperature queries can be erroneous in relation to one read correctly. If you set the value to 100 it will mean that if at least 1 in a 100 readings is correct, the temperature for the chosen thermometer will not disappear.
Of course, as the controller is getting erroneous readings (with incorrect CRC control sum) then it is not refreshing thermometers until it gets at least one correct reading in the chosen range.

For bus testing and initial observation the value set should be ‘0’. For normal use the value should be between ‘5’ and ‘10’. In case of very bad communication the maximum value can be 250.

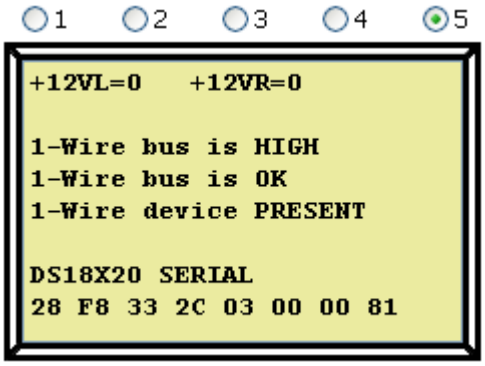
The information about the status of the bus and the serial number will be refreshed every second without regard to what is set in the ‘1-W ERR’ field. Therefore bus errors will be visible in these fields even though momentary thermometer disappearances will be ignored.

17.2. How to read the thermometer's serial number

To read the serial number you need connect the thermometer to the device like in the diagram below:



When you connect the thermometer, it's serial number will be visible on the bottom of window 5 of the display.

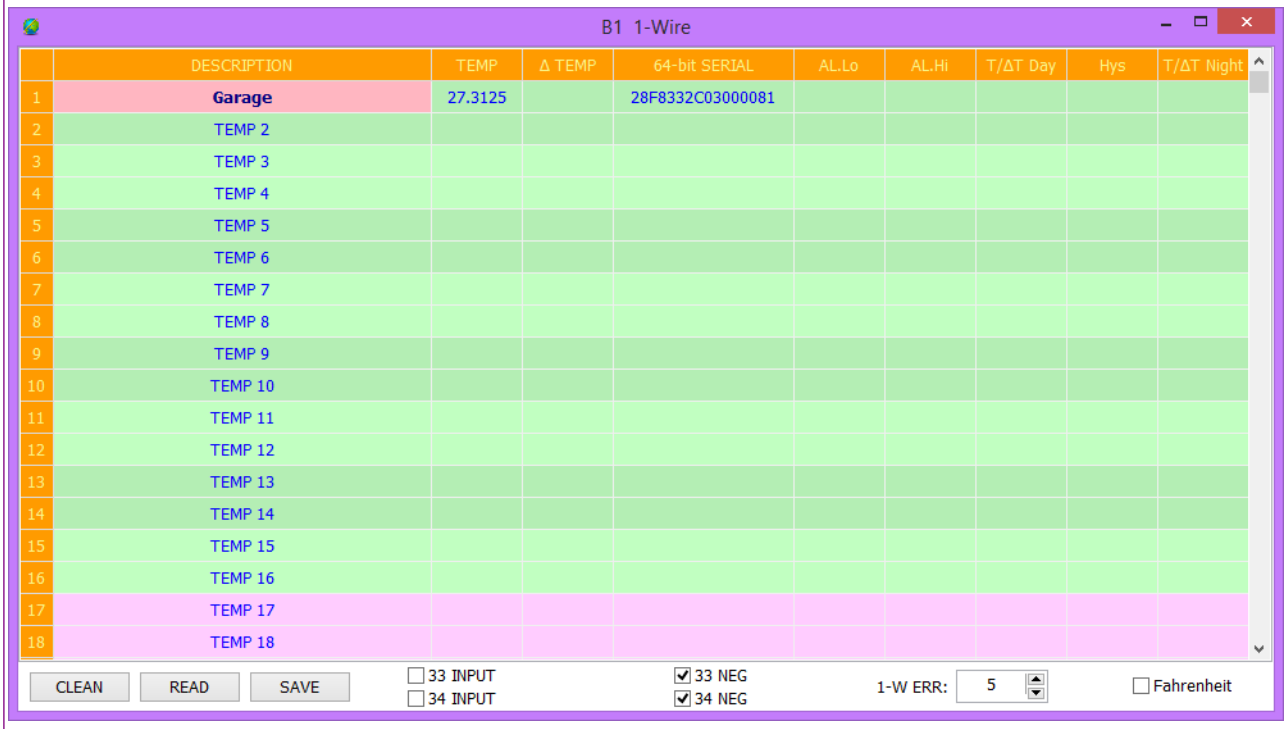


You need to write it down and then enter it in the list of thermometers.
Enter the serial number in the '64-bit SERIAL' column.

When you enter the serial number the thermometer will be visible on the list but will not yet show any temperature. It will show the real temperature only after you connect the thermometer to the bus.

The 'DESCRIPTION' column is used to make a description of a chosen thermometer, e.g. 'Yellow bedroom'.

This is how the window looks after all is entered:



Remember that the **serial numbers** are saved **in the device** when you press the SAVE button. They will be visible on any computer that connects to the device.

However, the thermometer names are saved in the '**myrelays.xml**' file which is created automatically in the folder where the program is located.
Different users may assign different names to the same thermometers on their individual computers or mobile devices. The file can be copied to a different computer.

When you first save the thermometer configuration, all the free spaces are assigned numbers from 1 to 33 (DESCRIPTION). Field 33 is used to enter the serial number of the DS2408 IC based relays.

Remember to always save the configuration after adding and naming a thermometer.

You can read all thermometer number in the beginning and immediately enter them and save them in the device.

As you are connecting succesive thermometers to the bus and assigning them names, you can place them on the top of the list or group them in any way you want, e.g. make group based on where in the building the thermometers are placed.

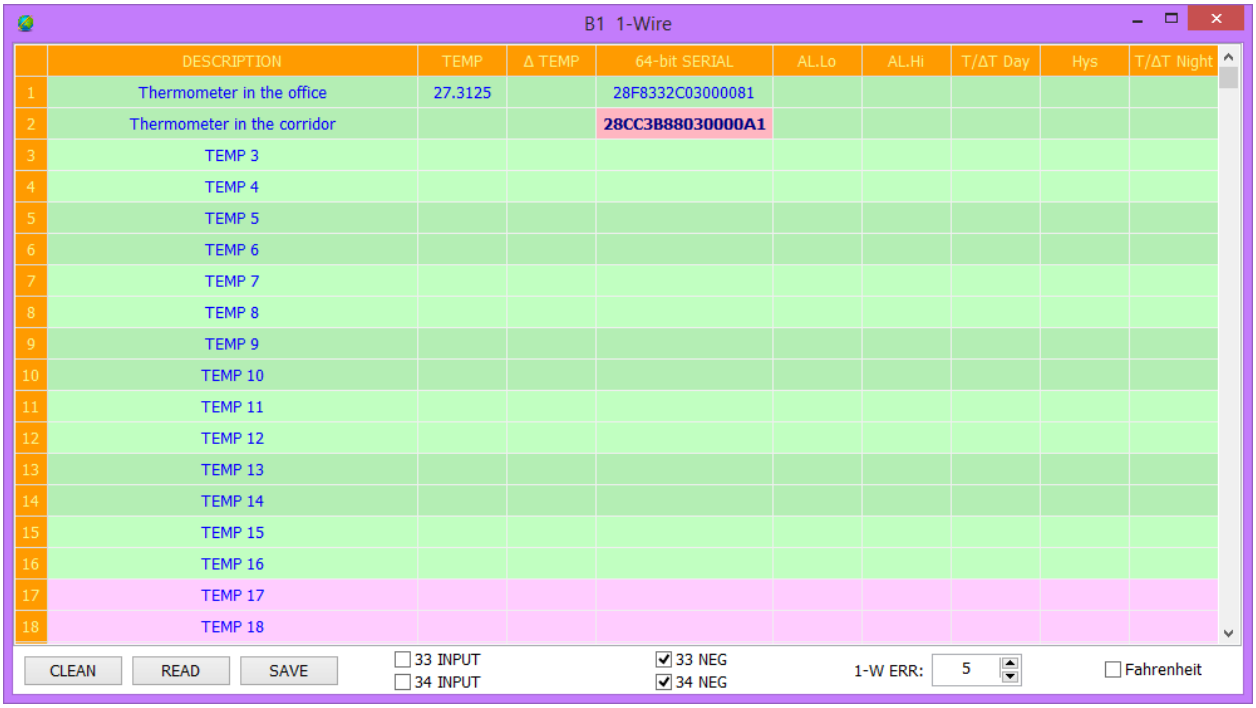
Important

If you have 1-Wire DS18B20 thermometer serial numbers entered but these thermometers are not physically connected to the device then the maximum/minimum temperature value exceeding alarm will occur and inform you about damage to the sensor or the bus itself. The device treats the entered thermometer as broken, not disconnected, and does not know whether this event is a thermometer malfunction or the thermometer is missing. If you have such thermometers then you should change the first to numbers in the serial numbers to zeros.

28xxxxxxxxxxxxxx → 00xxxxxxxxxxxxxx
10xxxxxxxxxxxxxx → 00xxxxxxxxxxxxxx

You will not lose the serial number but the field with the unconnected thermometer will be blocked.

As you can see on the picture below, the **Thermometer in the office** is connected and is showing the temperature but the **Thermometer in the corridor** is only entered in the device, assigned a name but is not yet connected.



17.3. Relay modules and input/output modules connected to 1-Wire

In addition to the thermometers, you can also connect:

- up to 2 boards with eight relays based on the DS2408 IC
- up to 2 modules with inputs/outputs based on the DS 2408 IC
- one relay module and one input/output module.

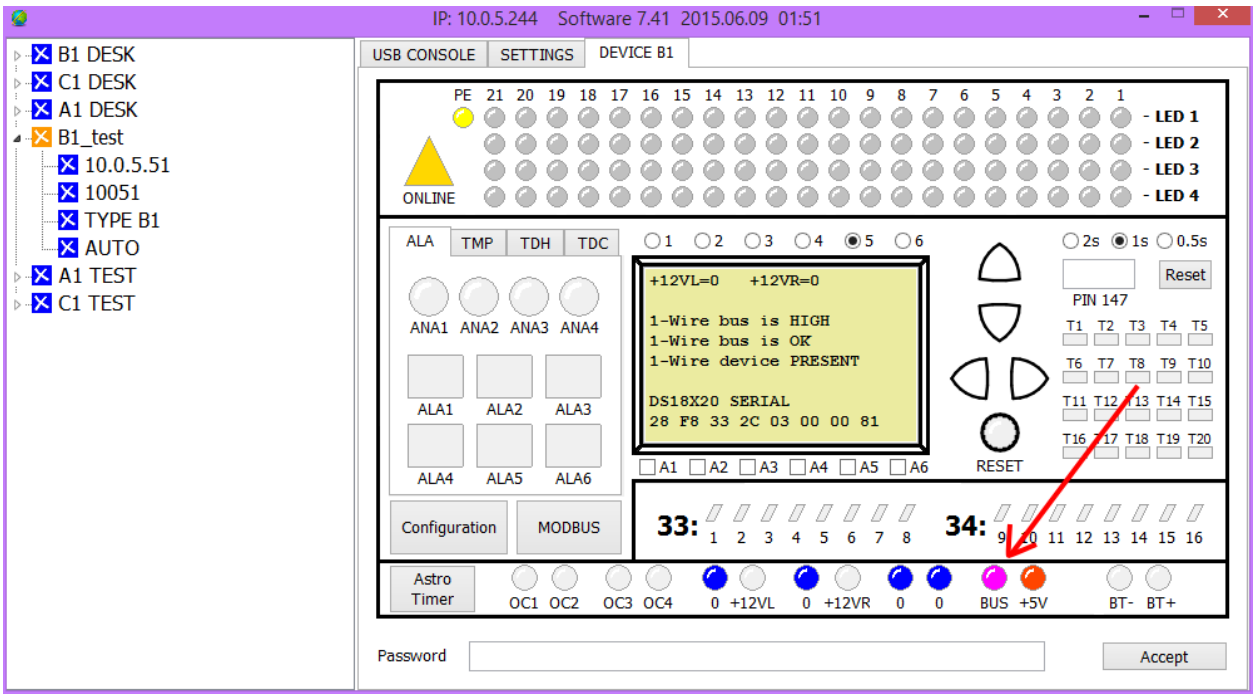
The last two positions (33 and 34) in the 1-Wire settings are used to enter their serial numbers.

The procedure is the same as with thermometers.

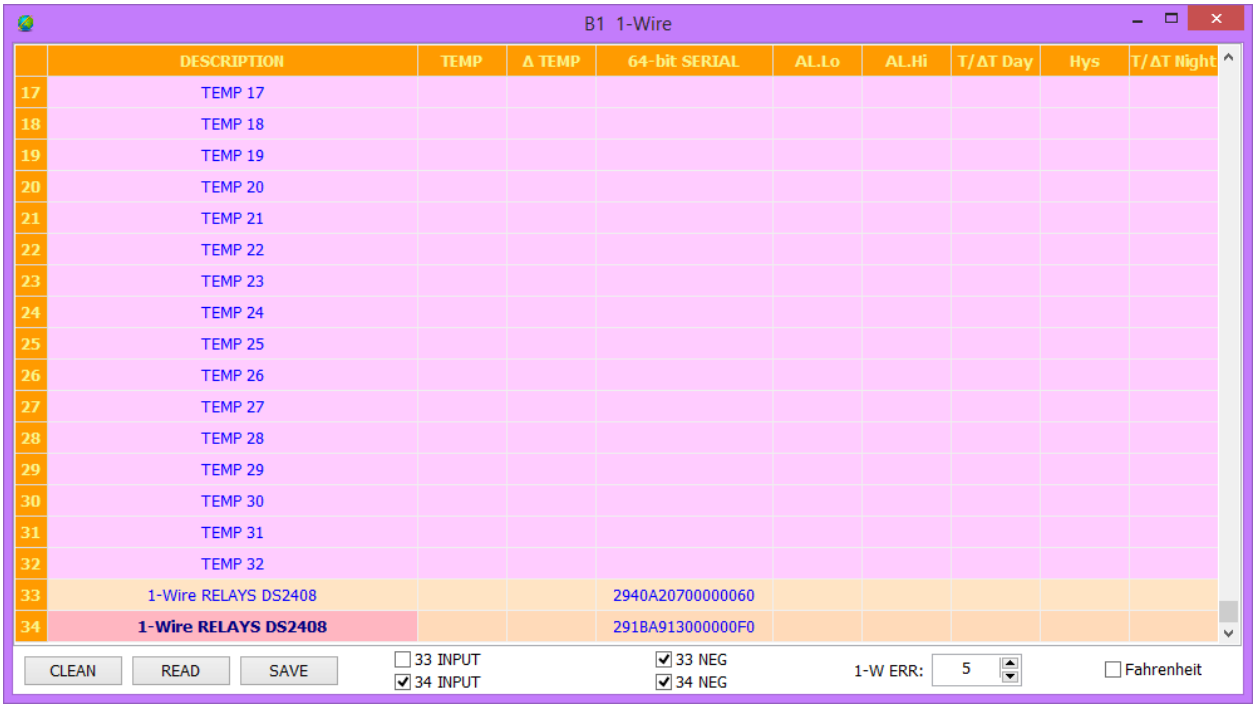
Using these modules you expand the device by another 8 or 16 relays.

In the 1-Wire thermometer window you pick whether you want the modules to work as inputs or outputs.

Click the BUS icon.



The 1-Wire settings window will pop out.
Scroll to the bottom.



There are two checkboxes there

33 INPUT
34 INPUT

Checking the box will make the chosen module work as inputs.

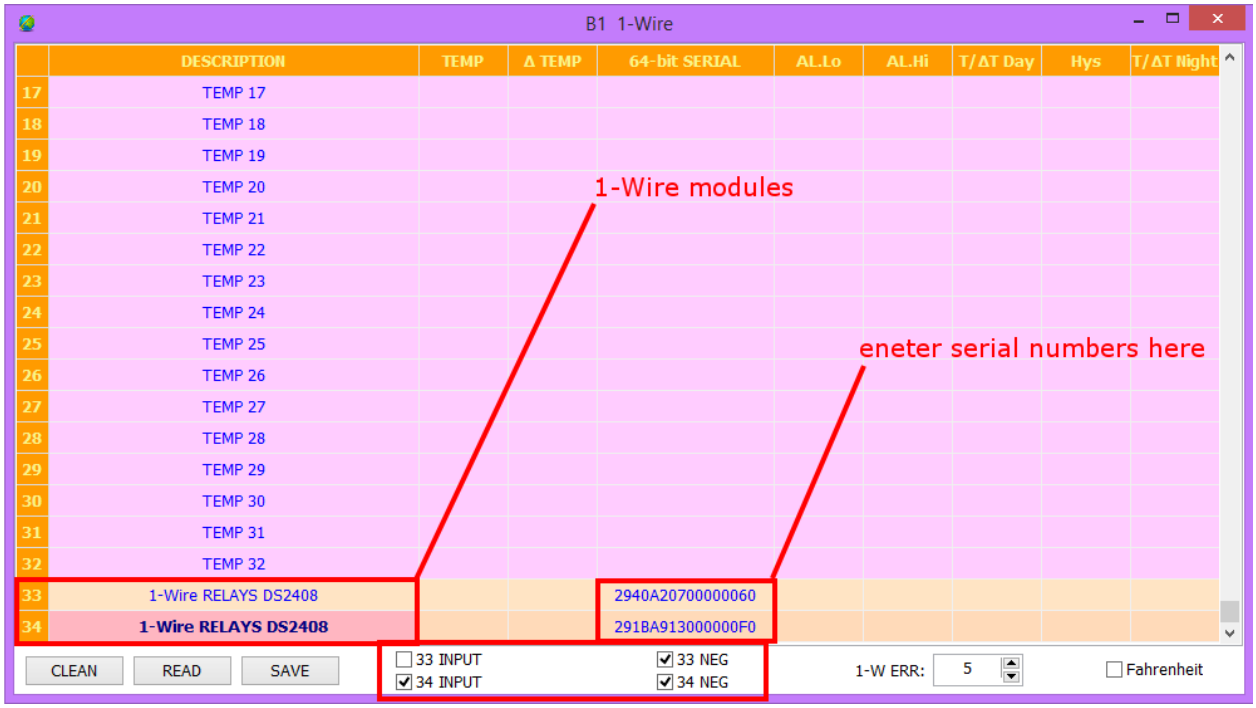
E.g. checking the 34 INPUT box will make the second module work in input mode.

1-Wire module serial numbers are on the bottom of the list – positions 33 and 34.
The numbers above are the serial numbers of the thermometers.

Check boxes:

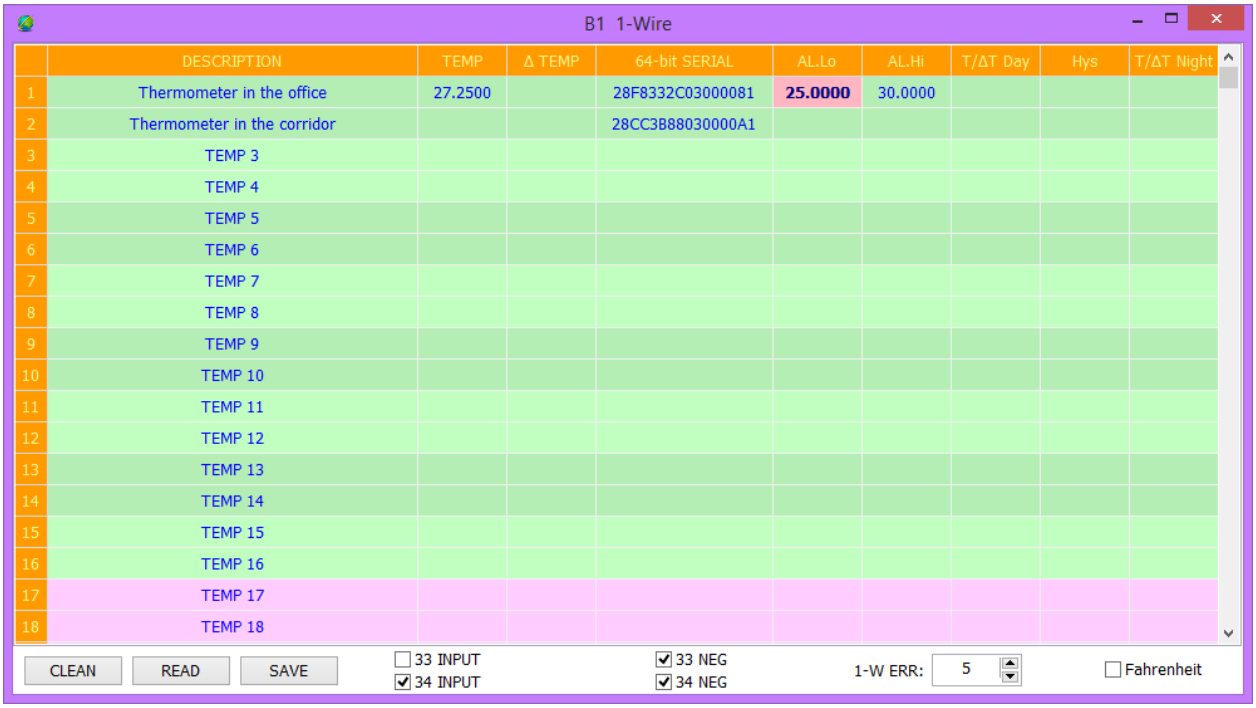
33 NEG
34 NEG

are used to switch polarization to the opposite – adjust the electric signal polarization to the connected module – 0 is off, 1 is on.



17.4. Thermometer alarms

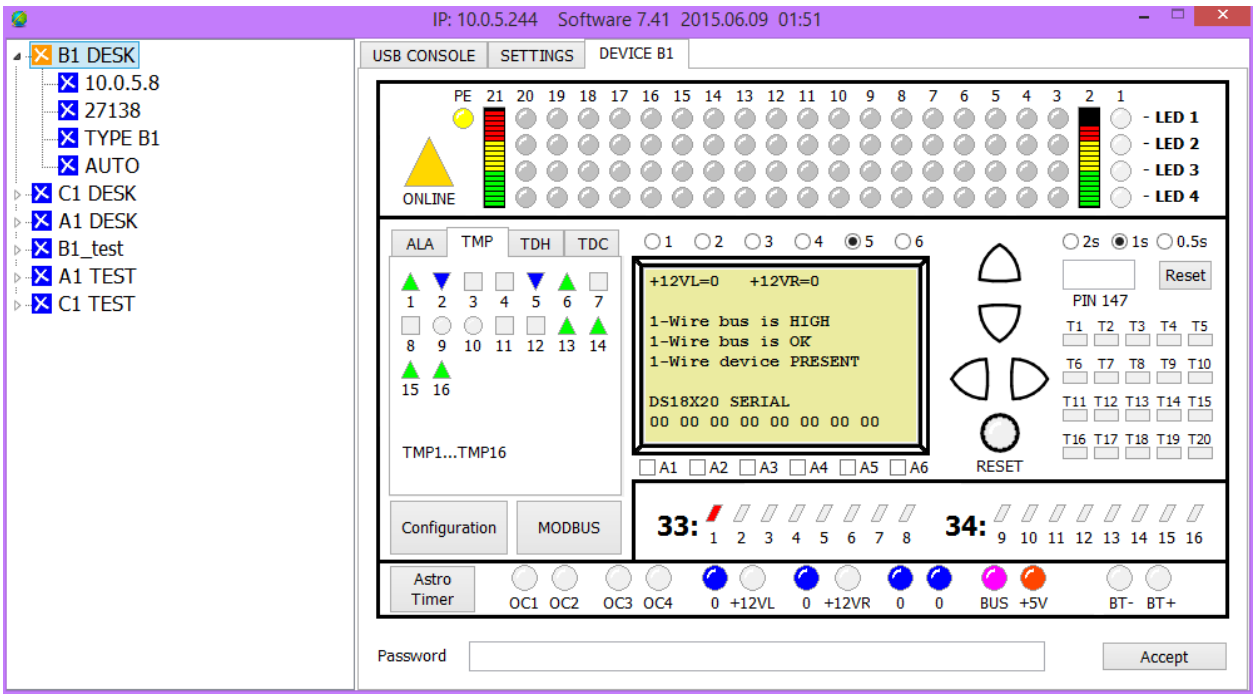
In the last AL.Lo and AL.Hi columns you can enter two limit values for temperature alarms. If the temperature crosses any of these values, this information can be used as a variable in building equations in OC output configuration, 1-Wire input/output configuration and T1-T20 timers. This can be a freezing or overheating alarm. If you leave these columns empty, no alarm will be executed.



18. THERMOREGULATORS

Each DS18 thermometer can operate like a simple thermometer with no additional features or as a single thermoregulator with regulated hysteresis.
This way you can build 16 simple thermoregulators.

Simple thermoregulators – heating or cooling (variables TMP1...TMP16)



What does each icon represent?

- a green triangle pointing up means the thermoregulator is expressing a need for heating or cooling and sets up variable TMPx

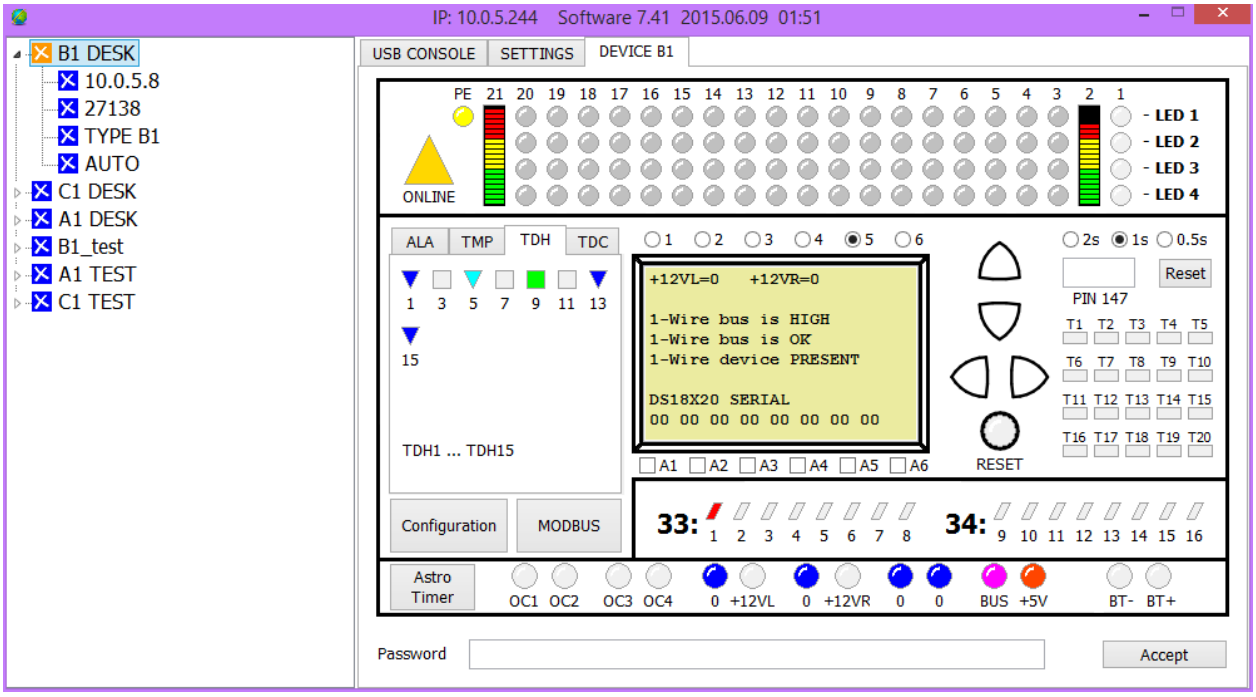
- a blue triangle pointing down means the TMPx variable is inactive due to being in the hysteresis range after crossing the wanted temperature level for either heating or cooling. The sign of the hysteresis shows whether the process is cooling or heating

- a blinking red circle means there is a problem, a thermometer which serial number was entered is missing and provides no temperature readings

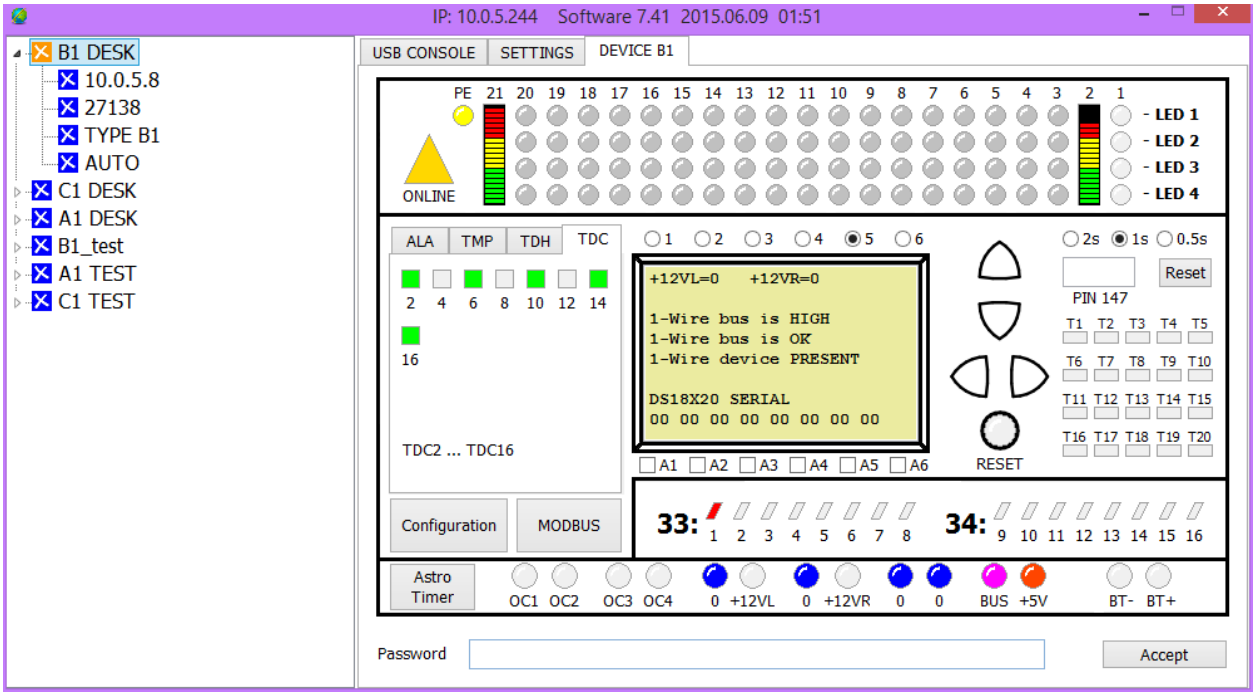
- a gray rectangle depicts a unprogrammed thermoregulator

Each pair of DS18 thermometers can work as a differential thermoregulator. You can build 8 differential thermoregulators with regulated hysteresis. You build them in pairs in green fields.

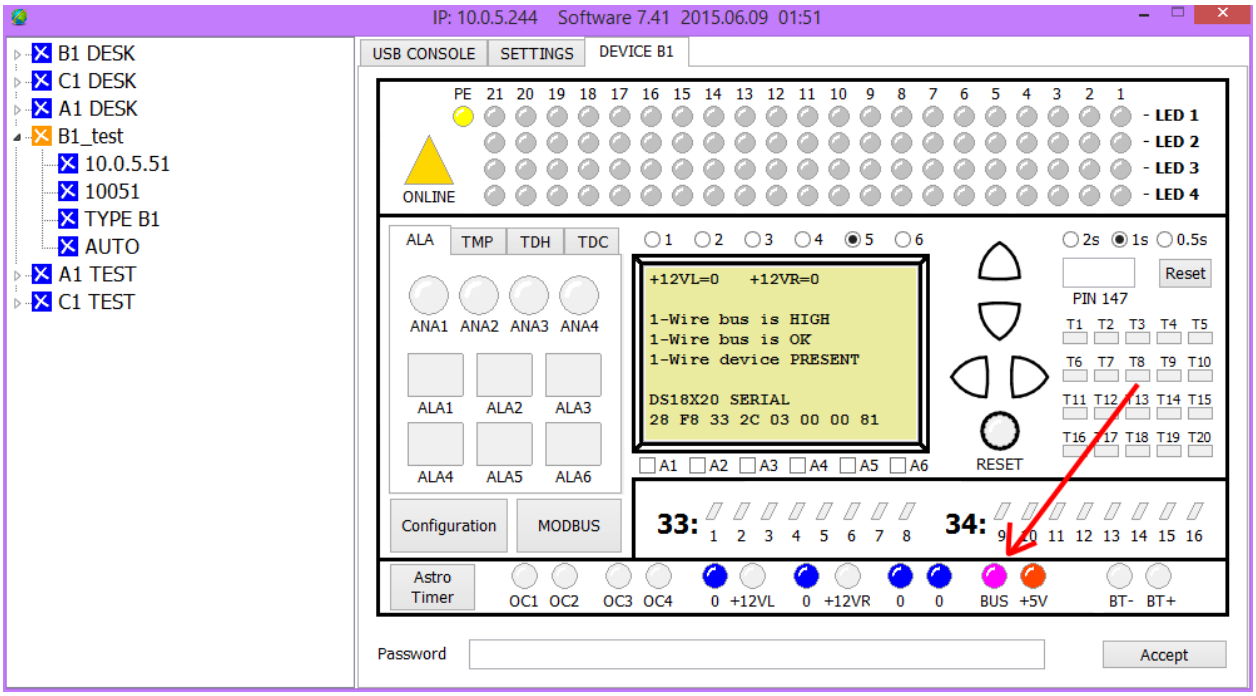
Differential thermoregulators – heating (Variables TDH1...TDH15 odd numbers only)



Differential thermoregulators – cooling (Variables TDH2...TDH16 even numbers only)



To enter the thermoregulator and thermometer configuartion and programming menu you need to double-click the **“BUS”** light.

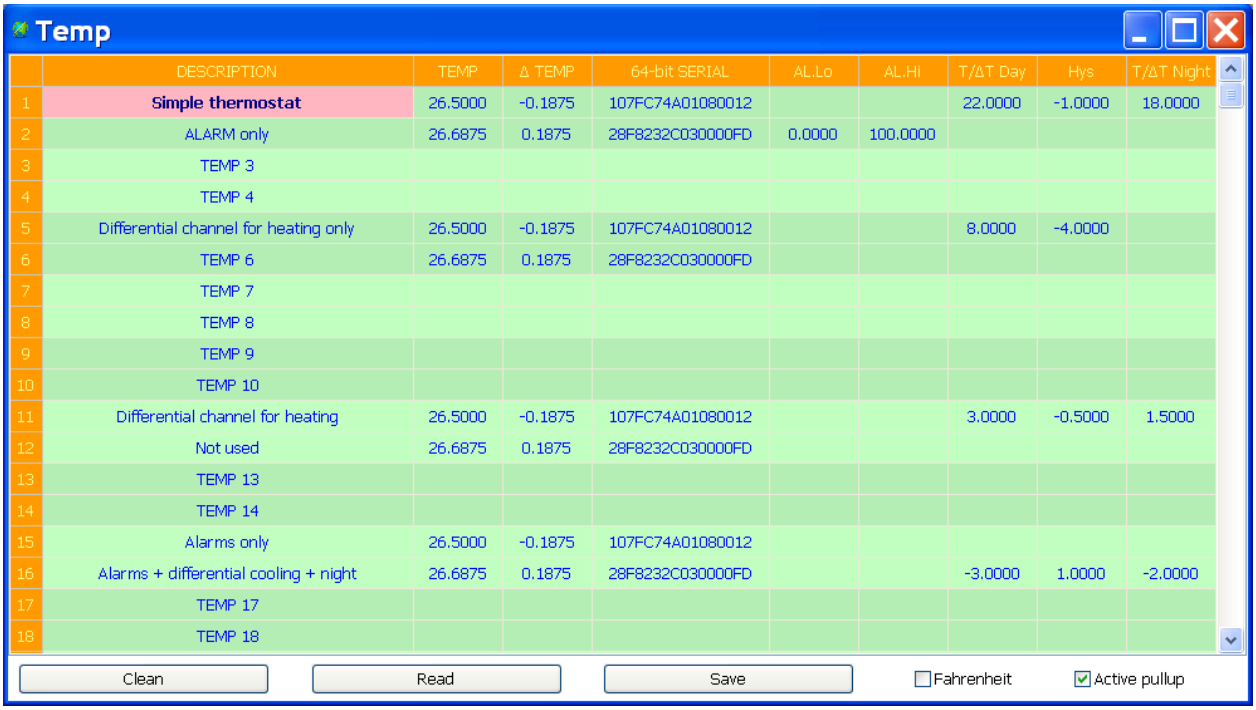


18.1. THERMOREGULATORS – basic concepts

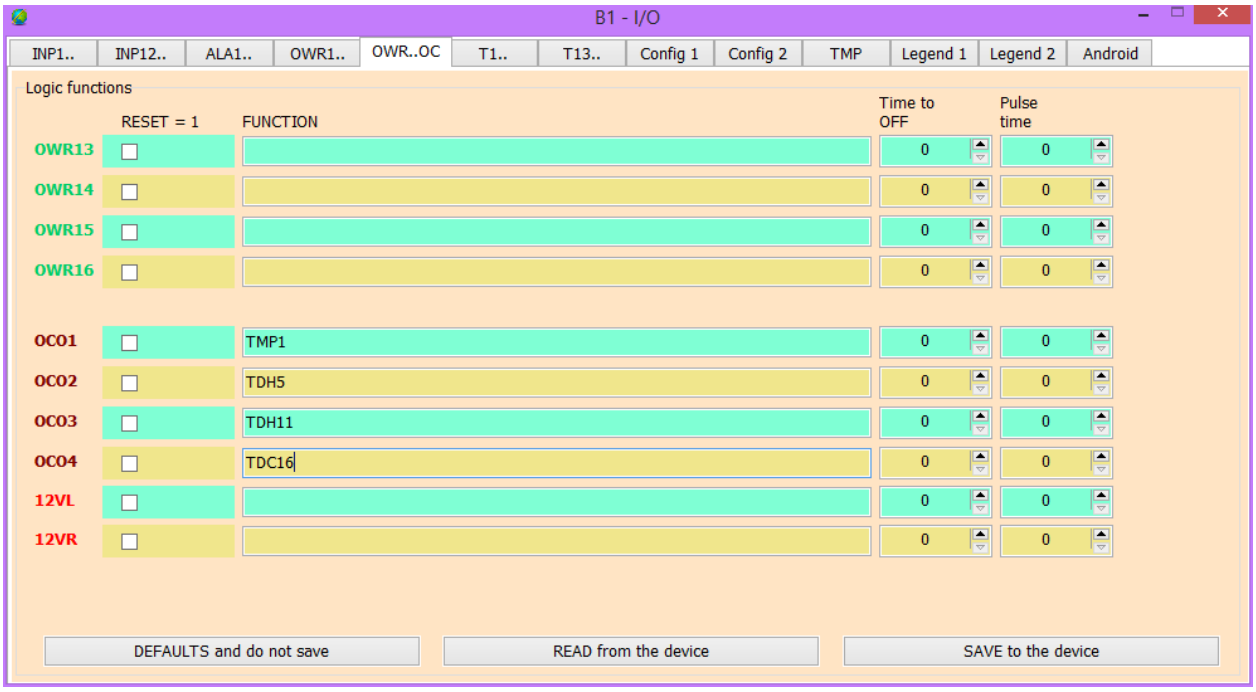
Basic concepts:

- negative hysteresis value – heating mode
- positive hysteresis value – cooling mode

Example:



And these are thermoregulators connected to outputs OCO1...OCO4
Each kind of thermoregulator has it's corresponding set of variables. Each line in the thermometer window corresponds to one numbered variable.


B1 - I/O
INP1.. | INP12.. | ALA1.. | OWR1.. | OWR..OC | T1.. | T13.. | Config 1 | Config 2 | TMP | Legend 1 | Legend 2 | Android
Logic functions
RESET = 1 | FUNCTION | Time to OFF | Pulse time
OWR13 | 0 | 0
OWR14 | 0 | 0
OWR15 | 0 | 0
OWR16 | 0 | 0
OCO1 | TMP1 | 0 | 0
OCO2 | TDH5 | 0 | 0
OCO3 | TDH11 | 0 | 0
OCO4 | TDC16 | 0 | 0
12VL | 0 | 0
12VR | 0 | 0
DEFAULTS and do not save
READ from the device
SAVE to the device

Each thermometer or thermometer working as a simple thermoregulator can work also as a sensor of:
- too high/too low temperature (variables AL1...AL16)
- AL variables can be connected with other into logic functions

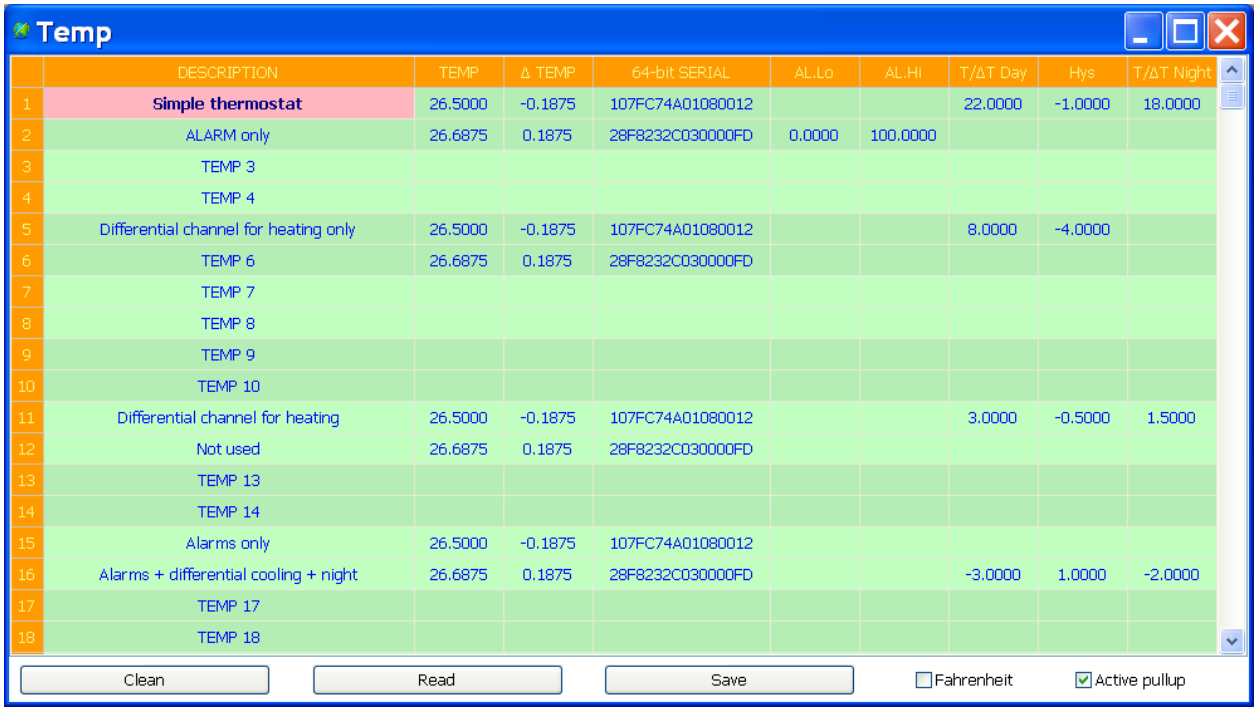
”T/ΔT” mean:
T – day or night temperature for a simple thermoregulator
ΔT – day or night temperature difference for a differential thermoregulator

T/ΔT Day – Day temperature at which heating or cooling are switched off.
T/ΔT Night – Night temperature at which heating or cooling are switched off.
Hys – Hysteresis. When the entered value is negative then the thermoregulator works in heating mode, when positive then in cooling mode, when zero the thermoregulator will not work.

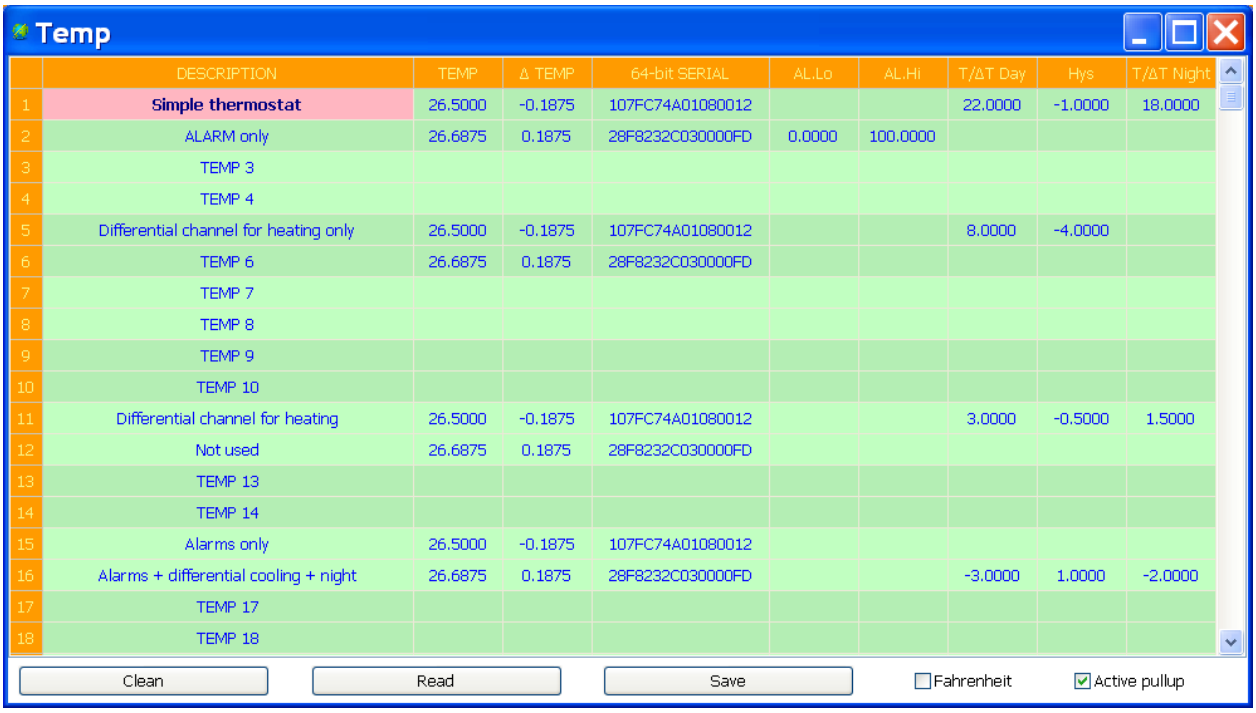
The temperature at which at which the processes are switched on again including the hysteresis is a result of the following equation: T/ΔT + Hys. The result is decided by the hysteresis sign. E.g. if the hysteresis is negative (-1°C) and the temperature set is T/ΔT=22°C the system will work in the following way. It will heat up to 22°C, swtich off, what until the temperature falls to 22°C–1°C=21°C and then switch on again.

If the hysteresis is positive then the result of the T/ΔT + Hys equation will be 22°C+1°C=23°C. The system will cool down to 22°C, stop cooling and then start again when the temperature reaches 23°C.

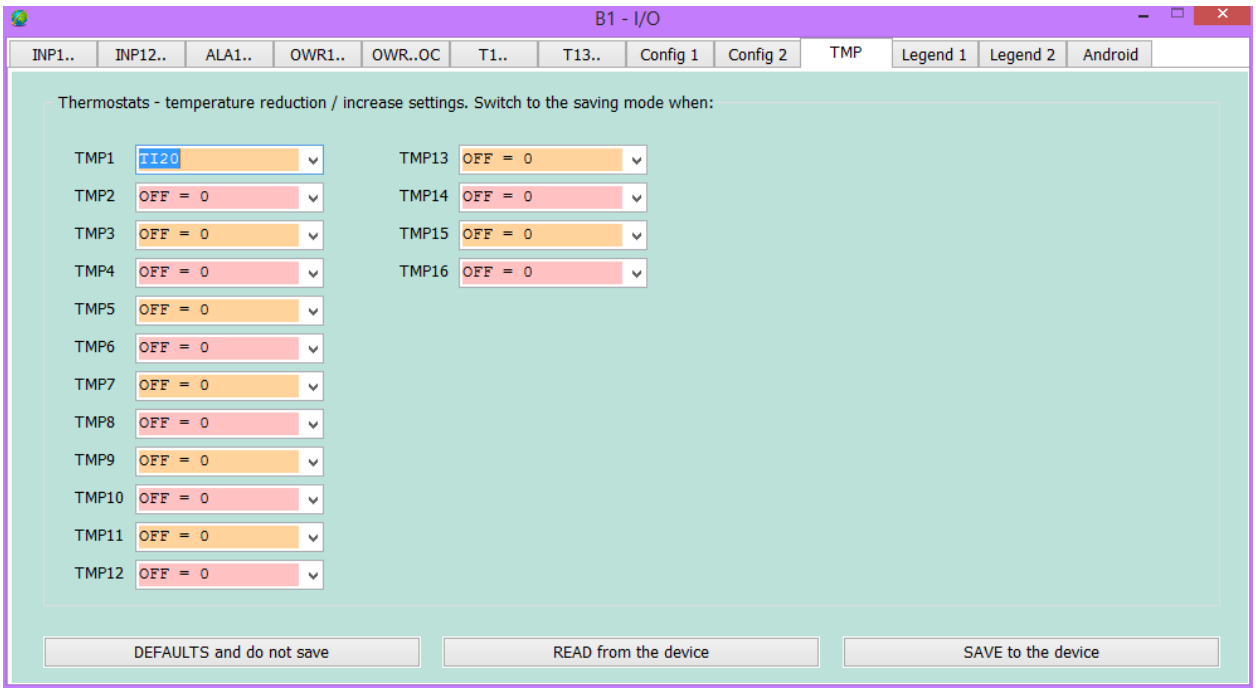
To connect the thermoregulators to outputs you use variables TMP1...TMP16. The number of the line form the thermometer window corresponds to the number of the TMP variable.
An example of picking both too low (< 0°C) and too high (> 100°C) alarm temperatures.AL1...AL16 variables are connected to temperatures exceeding the upper value and to temperatures falling below the lower value. In the example below (position 2 – Alarm only) – the lower value=0.0000 and the higher=100.0000.



For the temperatures to be dependable on the time of day, clock, Astro Timer or any other condition you need to enter the value of the lower temperature in the last column of the 1-Wire settings. In this example the temperature entered was T/ΔT Night = 18°C in line 1.



Nightly temperature drop is the name used for a change in temperature for a period of time. If you leave this field empty then there will be no temperature drop.
You need to program the clock/Astro Timer if you want to use it. Instructions on how to do it are in a separate part of this manual. You also need to assign a variable which will trigger the nightly drop. Each thermoregulator can have a different nightly drop variable. Usually you should use any empty T variable to build a condition for the nightly drop.
E.g. T20= ((~R) & OCO1) and choosing T20 as the condition causing the temperature drop.


B1 - I/O
INP1.. | INP12.. | ALA1.. | OWR1.. | OWR..OC | T1.. | T13.. | Config 1 | Config 2 | TMP | Legend 1 | Legend 2 | Android
Thermostats - temperature reduction / increase settings. Switch to the saving mode when:
TMP1 TI20
TMP2 OFF = 0
TMP3 OFF = 0
TMP4 OFF = 0
TMP5 OFF = 0
TMP6 OFF = 0
TMP7 OFF = 0
TMP8 OFF = 0
TMP9 OFF = 0
TMP10 OFF = 0
TMP11 OFF = 0
TMP12 OFF = 0
TMP13 OFF = 0
TMP14 OFF = 0
TMP15 OFF = 0
TMP16 OFF = 0
DEFAULTS and do not save
READ from the device
SAVE to the device

Examples:

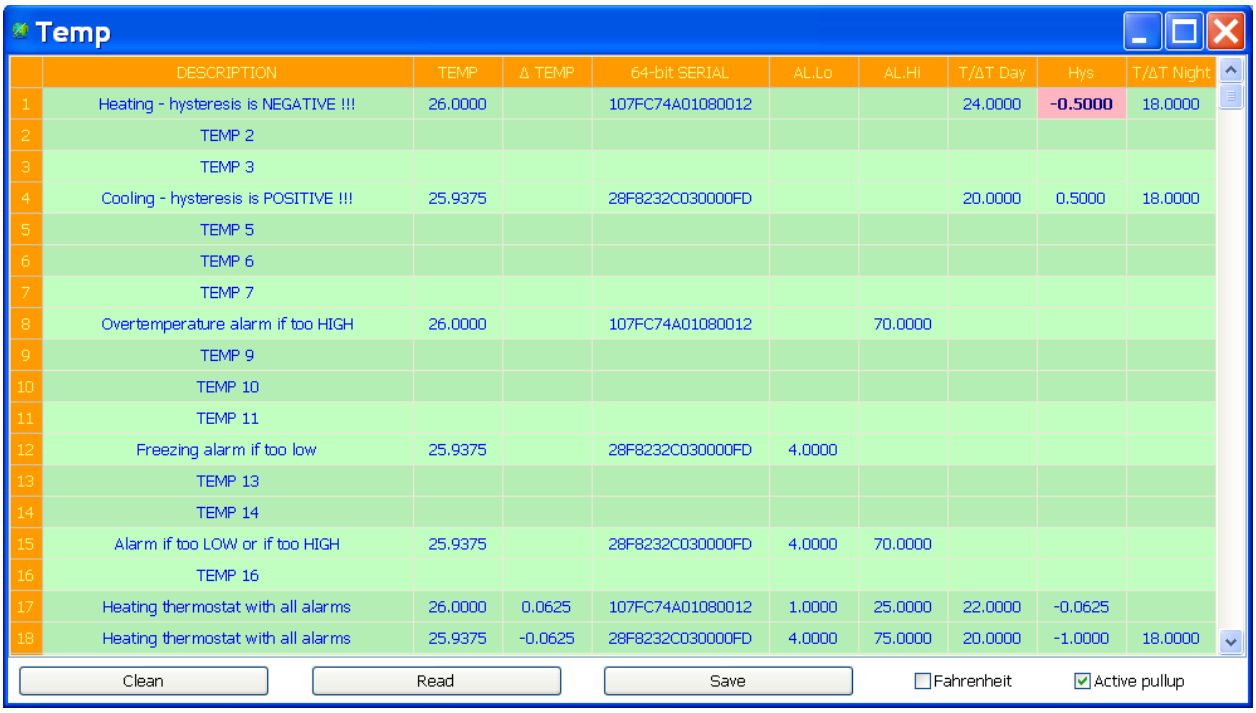
Heating mode example:
If T/ΔT = 24.0000°C and Hys = -0.5000°C (negative hysteresis value) then the thermoregulator is in working in heating mode. The thermoregulator will switch off the heating when the temperature rises above 24.0000°C and switch in on again when it falls half a degree to 23.5000°C.

Cooling mode example:
If T/ΔT = 20.0000°C and Hys = +0.5000°C (positive hysteresis value) then the thermoregulator works in cooling mode. The thermoregulator will switch off the cooling when the temperature falls to 20.0000°C and will switch it on again when it rises half a degree to 20.5000°C

Thermoregulator off:
When you enter 0 into the Hys field or you leave the Hys field empty and save the settings then the chosen thermometer will stop working as a thermoregulator.

The alarms for crossing temperature levels (AL Lo and AL Hi) work even if the thermoregulator option is switched off. They can be used as variables AL1...AL16

This is an example of possible configurations of simple thermoregulators and temperature level crossing alarms. The nightly drop is in the last column. The nightly drop is not a binding name and can be activated with any chosen variable.


Temp
DESCRIPTION
TEMP
Δ TEMP
64-bit SERIAL
AL.Lo
AL.Hi
T/ΔT Day
Hys
T/ΔT Night
1 Heating - hysteresis is NEGATIVE !!! 26.0000 107FC74A01080012 24.0000 -0.5000 18.0000
2 TEMP 2
3 TEMP 3
4 Cooling - hysteresis is POSITIVE !!! 25.9375 28F8232C030000FD 20.0000 0.5000 18.0000
5 TEMP 5
6 TEMP 6
7 TEMP 7
8 Overtemperature alarm if too HIGH 26.0000 107FC74A01080012 70.0000
9 TEMP 9
10 TEMP 10
11 TEMP 11
12 Freezing alarm if too low 25.9375 28F8232C030000FD 4.0000
13 TEMP 13
14 TEMP 14
15 Alarm if too LOW or if too HIGH 25.9375 28F8232C030000FD 4.0000 70.0000
16 TEMP 16
17 Heating thermostat with all alarms 26.0000 0.0625 107FC74A01080012 1.0000 25.0000 22.0000 -0.0625
18 Heating thermostat with all alarms 25.9375 -0.0625 28F8232C030000FD 4.0000 75.0000 20.0000 -1.0000 18.0000
Clean
Read
Save
Fahrenheit
Active pullup

18.2. DIFFERENTIAL THERMOREGULATORS

Any neighboring pair of thermometers can work also as a more advanced differential thermoregulator.

In the 1-Wire configuration menu neighoring rows are displayed in the same shade of green – brighter or darker. Only the fields of the same shade can be used to build a differential thermoregulator. The device does not need to be informed in any way that you want to create a differential thermoregulator. You just need to enter real values into fields ”T/ΔT” i ”Hys” and assign the differential thermoregulator in the output configuration window using the corresponding variable.

TDH1...TDH15 (odd numbers) differential thermoregulator – heating
TDC2...TDC16 (even numbers) differential thermoregulator – cooling

If you enter differential thermoregulator variables then you need to ignore TMP variables as they will not have any sense.

The differential regulator measures the difference between two thermometers while at the same time calculating two addition equations. One for heating, one for cooling.

For example, for rows 1 and 2:
Row 1: T/ΔT = 8.0000°C Hys = -4.0000°C (differential temperature positive, hysteresis value negative) the equation is 8°C + (-4)°C = 4°C. The relay will switch on when the T1-T2 difference reaches 8°C and will switch off when the T1-T2 difference falls down to 4°C.

Row 2: T/ΔT = -8.0000°C Hys = +4.0000°C (Temperature difference T2-T1 negative, hysteresis value positive) the equation is -8°C + 4°C = -4°C. The relay will switch on then the T2-T1 difference reaches -8°C and will switch off when the T2-T1 differens reaches -4°C.

Please remember that the values described are temperature differenes, not negative temperature values and it makes no difference if measured values are positive or negative.

Temperature differences are shown in the „ Δ TEMP” fields. T1-T2 in the upper one and T2-T1 in the lower one.

You can limit the differential thermoregulators operation in a way that will make them inactive when the absolute temperature value from one of the sensors will be out of it’s given range. See rows 5 and 6 in the picture below.

- when you enter e.g. 45°C in the Al Lo field of row 5 then the differential thermoregulator for heating will start working when the temperature falls below 45°C
- when you enter e.g. 85°C in the Al Hi field of row 5 then the differential thermoregulator for heating will stop working when the temperature exceeds 85°C

- when you enter e.g. 10°C in the Al Lo field of row 6 then the differential thermoregulator for cooling will stop working when the temperature falls below 10°C
-when you enter e.g. 20°C in the Al Hi field of row 6 then the differential thermoregulator for cooling will start working when the temperature exceeds 20°C

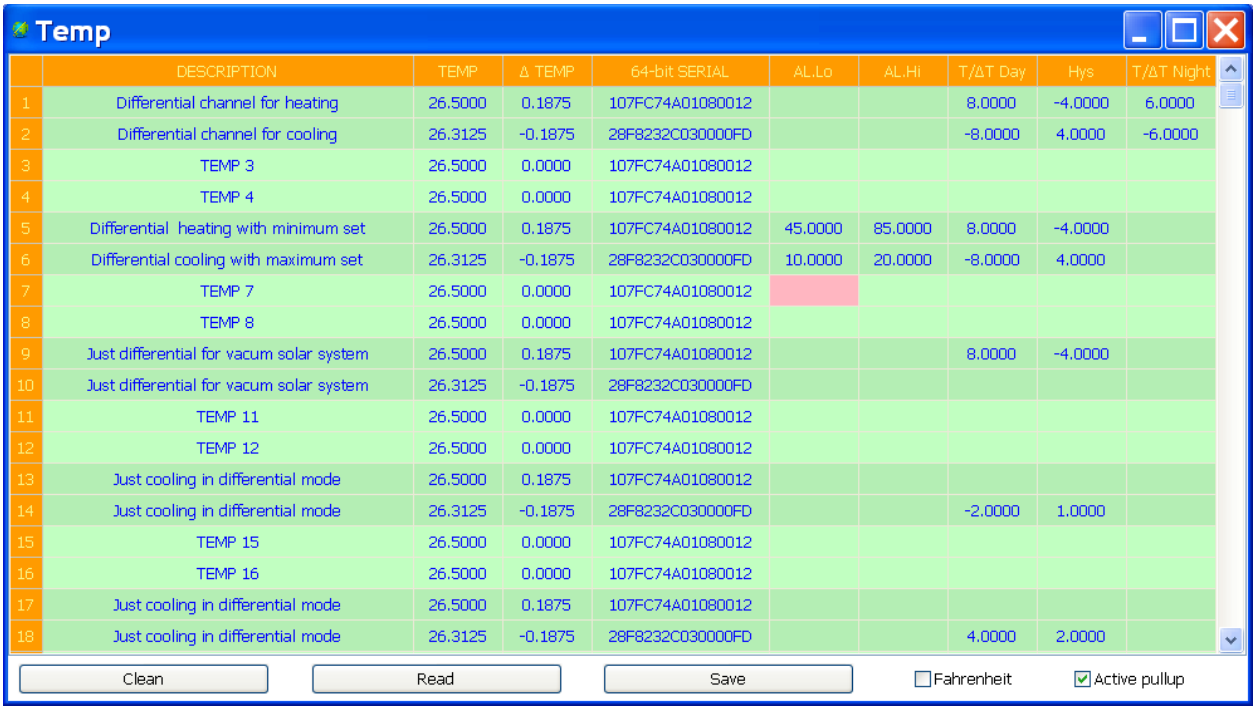
Switching Al Lo and Al Hi values makes no sense. The Lo field is always the lower limit of the

given range and the Hi field is always the upper limit. If you do not want to limit the thermoregulator work range when you should leave the fields empty as shown on the picture below

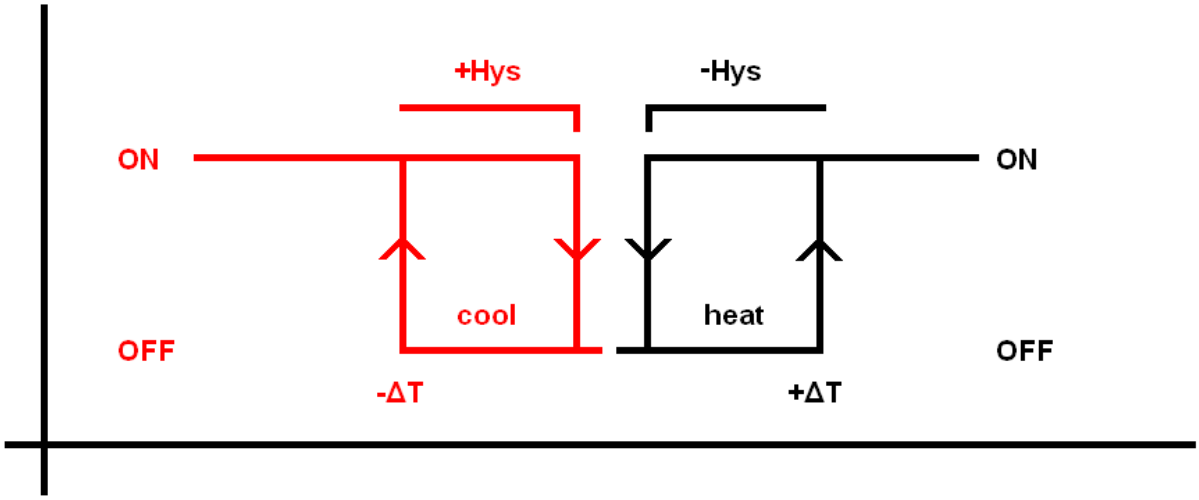
Once more, keep in mind these facts:

If you want to use differential thermoregulators then you need to enter a temperature difference in the T/ΔT field instead of a target temperature. You do not need to use heating and cooling at the same time.
From each pair of thermometers the upper one is the high heating channel and the lower one is the low cooling channel – see the picture below. You cannot change this as it was designed to work this way and will not work in any other configuration. Therefor with every pair of thermometers you need to set:

- Positive T/ΔT temperature differences in the upper fields of the same shade of green
- Negative hysteresis for heating in the upper fields of the same shade of green
- Negative T/ΔT temperature differences in the lower fields of the same shade of green
- Positive hysteresis for cooling in the lower fields of the same shade of green



Hysteresis diagram for heating and cooling:

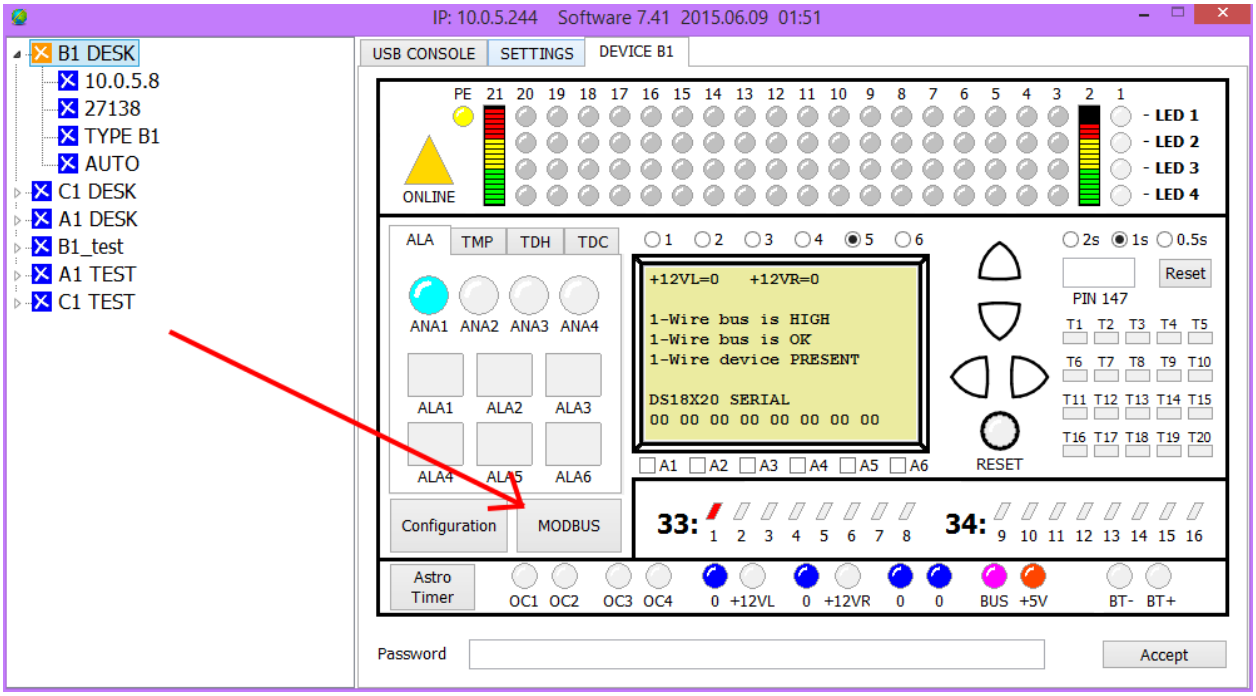


19. MODBUS Configuration window

The **Modbus** protocol was implemented in PLC2011B1 to make the resources of the device available for other devices or computers. In a cheap and easy way you can expand your installation, based on PLC, with additional interfaces. You can also use PLC2011B1 as an Internet interface controller for a bigger PLC using mobile and encrypted software.

For instance, if you have another manufacturer's PLC device equipped with a RJ45 input, you can share your resources with that device. You can control a different PLC device using an Android mobile device via PLC2011B1. PLC2011B1 can also act as a shield for your network as it has strong transmission encryption mechanisms with the AES-256 algorithm.

You can activate or deactivate an input or variable in your PLC2011B1 device using your Android phone and immediately send this information to a different PLC device in your ethernet network using the Modbus protocol. You can also connect your device's open collector outputs to another device's inputs.



PLC2011B1 uses the Modbus protocol to send out a command to a desired IP address, TCP or UDP port and MAC address.

PLC2011B1 uses TCP and UDP protocols for data transmission from the device to a chosen internet or local network address and does not expect a response or confirmation.

PLC2011B1 ignores any commands sent it's direction, ignore responses and does not react to other Modbus inquiries from other Master devices. A computer, other PLC device, router or any other device can be a recipient.

Due to a lot of errors in network protocol implementation in many older PLC devices, which are not supported anymore, we decided on the following configuration.

PLC2011B1 sends out TCP or UDP packets in the following way:

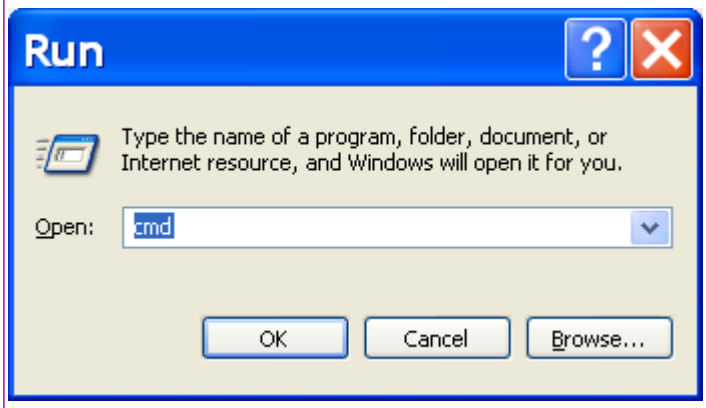
PLC2011B1 → different PLC

1. If "different PLC" is in your local network, the same subnetowork, the same network segment, that means it has a similar IP address, e.g.:

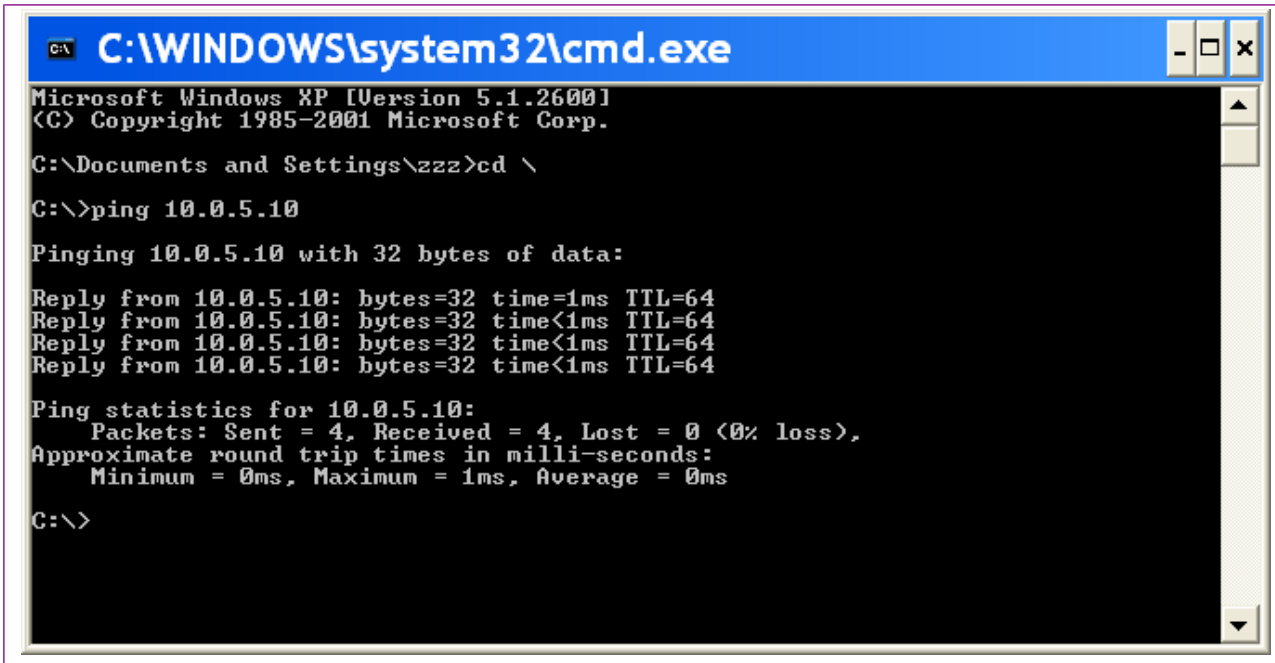
PLC2011B1: 10.0.5.5
different PLC: 10.0.5.10

Then you must establish what is that different PLC's MAC address and enter it in the appropriate field in the Modbus configuration window. The MAC address is a physical, device address of the ethernet interface. There are may ways to find out a MAC address. It can be printed on a sticker on a device, you can program your own address, use software dedicated for checking devices inside a network, check in the router or by doing a couple of simple operations.

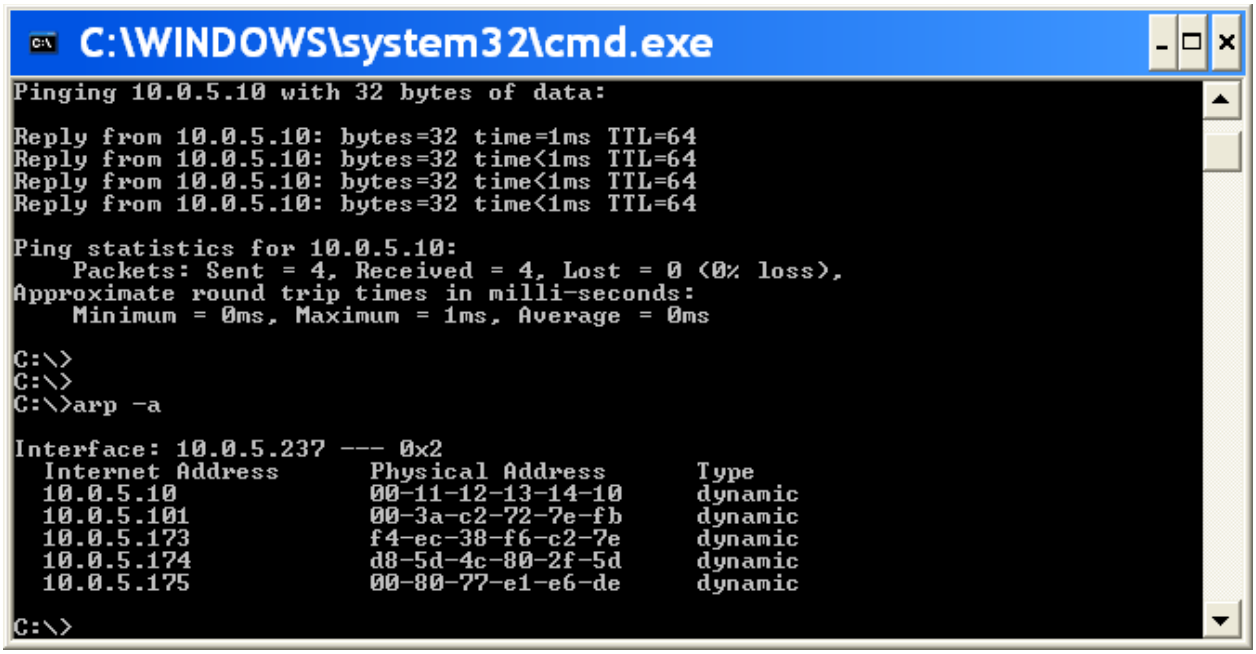
In Windows, run the CMD window (Start → Run → enter **cmd**)



In the cmd (command line) window enter:
c:\>ping 10.0.5.10 (there must be an answer – 3-4 packets if the "different PLC" is alive, you must of course know it's IP address)



Next enter:
c:\> arp -a



A table with IP and MAC addresses will be displayed. Write down the MAC address belonging to the IP address in question.
In the PLC2011B1 Modbus configuration you should enter:

IP:10.0.5.10 – IP address of the different PLC to which you will send out packets
port: 502 – TCP or UDP port of the different PLC to which you will send out packets
MAC: 00:11:12:13:14:10 – MAC addres of the different PLC to which you will send out packets

2. If the “different PLC” is ‘somewhere’ in the Internet, which means it has a completely different IP address (it must be a public address), then you must establish it’s router’s LAN interface IP address and the routers MAC address instead of looking for the “different PLC’s” IP and MAC address.

Knowing the router’s IP address you can establish it’s MAC in the way shown before, first pinging the router and then reading it’s arp table entering the “arp -a” line.

For example, you will receive this data which you must enter in the Modbus configuration field of your PLC2011B1 device:

IP: 10.0.5.1 – this will be the router’s IP address
port: 502 – this will be the TCP or UDP port of the remote PLC – you do not change this
MAC: 00:A2:1A:3F:D4:18 – this will be the router’s MAC address

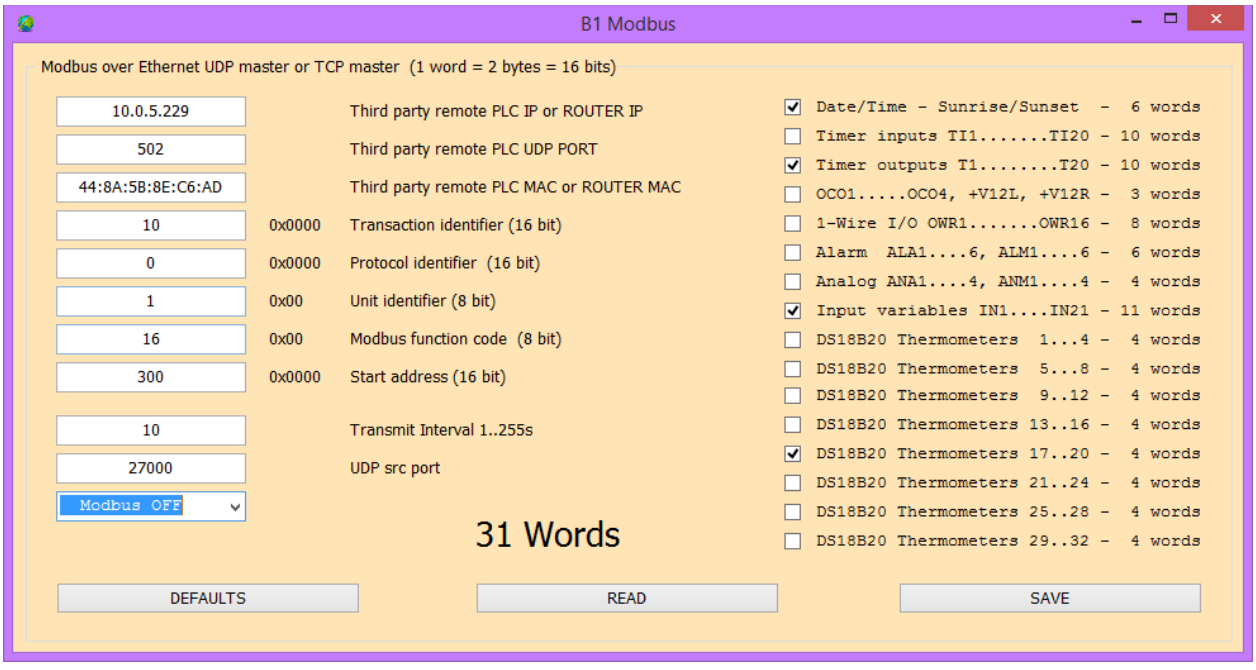
To resume, if the receiving device is in your local network, you send data directly to the device. If it is somewhere in the internet, you sen data to it’s router.

Modbus packets sent from PLC2011B1 to a different PLC reach the space in it’s memory entered in the **Start address (16 bit)** field, e.g. address no.300. Starting from this address, there will be as many 16bit words taken as is the total from the options you selected using the check boxes next to these options which interest you.

Every kind of data which is transmittable using PLC2011B1 has a defined length in 16 bit, 2 byte words and that many cells in the receiving PLC will be taken up, beginning from the start address.

The data is connected, ‘glued’ together.

If you select four check boxes, like in the picture below, then first six words will come from the **Date, Time and Sunrise/Sunset**, the next ten from **timer outputs T1-T20**, then the next eleven from **input variables IN1 - IN21** and the last four from **Thermometers 17...20**. They will be sent out in one packet in this order. The order goes from top of the list to the bottom.



Under the start address 300 of the receiving PLC you will find the first word of the **Date, Time and Sunrise/Sunset**, then the first word of **T1...T20** begins in 306, **IN1...IN21** start in 316 and **Thermometers 17...20** in address 327.

If you select another data segment which lies in between the currently selected one, then the data below the selected check box will be moved down by as many cells as needed for the new data segment. The data order in the receiving PLC will change.

You can use this data in the receiving PLC in any way you want, depending on your needs and abilities.

Other fields also require some explanation.

Some older PLC's with errors in Modbus implementation simply do not accept certain values entered in the fields **Transaction indentifier** and lower.

There are controllers which do not accept certain values and there is no logical explanation as to why this occurs. This concerns especially the **Transaction indentifier** value.

Remember that errors in entering the IP or MAC address will cause a total lack of transmission. The device will not receive anything and will not signal that something is wrong. These settings should be made carefully.

As the Modbus protocol is in no way secured from attacks at devices, encrypted or secured from impersonating devices, you should take steps to ensure safety of the wiring and separate the devices, which receive the transmission, from the internet with routers. Its good to configure a VPN tunnel between boundary routers. This exceeds the contents of this manual and you should consult a specialist on this matter.

Your PLC2011B1 sends out packets directly to the network interface of the destination PLC using it's MAC address without making ARP "who has" inquiry and without waiting for ARP "is at" response.

This is why you need to establish the destination MAC address 'manually'. This is an advantage as an intruder trying to intercept IP addresses and corresponding MAC addresses will not be able to 'hear' the devices. This is because ARP packets are sent to every switch port and are 'broadcast' packets which makes possible to use them to create a device list and impersonate these devices. Another reason to know the MAC address during configuration are examples of tested devices which did not have properly operating network protocols.

We advise you to use the UDP protocol for transmission instead of TCP. The UDP protocol generates highly lower network traffic between devices. Because the PLC2011B1 only sends out data to another device, the retransmission ability of the TCP is not needed and even undesirable as it generates unnecessary traffic and CPU usage. However, using the UDP protocol may not always be possible as some devices may not adapted to it's operation.

Using the **Modbus** protocol you can send out PLC2011B1 data from the AstroTimer, timer inputs TI1 – TI20, timer outputs T1 – T20, OC open collector outputs, R 1-Wire outputs, input variables IN1 – IN20 and thermometers. All signals are assigned to a group which is sent out together. You cannot send out a signal from a single input or variable. For instance, if you want to

send out the signal for OC3 you need to select the group OC1...OC4. Available signal groups are shown on the right of the Modbus configuration window. To select a group of signal you need to check the check box next to it.

What does each field mean?

- **Third party remote PLC IP or ROUTER IP –** IP address of the device that is supposed to receive the signal.
- **Third party remote PLC UDP PORT –** port used by the Modbus protocol. By default this is port 502.
- **Third party remote PLC MAC or ROUTER MAC –** MAC address of the device that is supposed to receive the signal
- **Transaction indentifier (16 bit) –**
- **Protocol indentifier (16 bit) –** this field is always 0 for Modbus messages
- **Unit indentifier (8 bit)**
- **Modbus function code (8 bit)**
- **Start address (16 bit) –** the place where data saving in the receiving device will start
- **Transmit Interval 1...255s –** how often will the device send out data to the receiver
- **UDP src port**
- **Modbus mode –** the type of used Modbus protocol. You can choose UDP, TCP or Modbus OFF

Byte		
0	Day of the week	0 = Sunday, 1 = Monday ...
1	Year HIGH byte	
2	Year LOW byte	
3	Month	
4	Day	
5	Hour	Real time clock and astronomic timer for the actual day
6	Minutes	
7	Seconds	
8	Sunrise HIGH byte	
9	Sunrise LOW byte	
10	Sunset HIGH byte	
11	Sunset LOW byte	

12	Open collector output 1	Open collector outputs:
		
		This is the formula for OC and DS2408 outputs:
		
		if (OC & 0x81) == 0x01) {
		ON ;
		NOT Flashing;
		}
		else
		if (OC & 0x81) == 0x81) {
		ON;
		Flashing;
		}
		else {
		OFF;
		NOT Flashing;
		}

13	Open collector output 2	
14	Open collector output 3	
15	Open collector output 4	
16	Open collector output 5	
17	Open collector output 6	
18	Open collector output 7	
19	Open collector output 8	
20	Open collector output 9	
21	Open collector output 10	
22	Open collector output 11	
23	Open collector output 12	
24	Open collector output 13	
25	Open collector output 14	
26	Open collector output 15	
27	Open collector output 16	
28	Open collector output 17	
29	Open collector output 18	
30	Open collector output 19	
31	Open collector output 20	
32	Open collector output 21	
33	Open collector output 22	
34	Open collector output 23	
35	Open collector output 24	

36	1-Wire relay DS2408 at R33 - 0	Extension board based on the DS2408 chip with 8 relays. This R33 marked board is defined at row **33** of the temperature/thermostat settings. The logic formula is the same as for open collector outputs (18 to 41 above).
37	1-Wire relay DS2408 at R33 - 1	
38	1-Wire relay DS2408 at R33 - 2	
39	1-Wire relay DS2408 at R33 - 3	
40	1-Wire relay DS2408 at R33 - 4	
41	1-Wire relay DS2408 at R33 - 5	
42	1-Wire relay DS2408 at R33 - 6	
43	1-Wire relay DS2408 at R33 - 7	
44	1-Wire relay DS2408 at R34 - 0	Extension board based on the DS2408 chip with 8 relays. This R33 marked board is defined at row **34** of the temperature/thermostat settings. The logic formula is the same as for open collector outputs (18 to 41 above).
45	1-Wire relay DS2408 at R34 - 1	
46	1-Wire relay DS2408 at R34 - 2	
47	1-Wire relay DS2408 at R34 - 3	
48	1-Wire relay DS2408 at R34 - 4	
49	1-Wire relay DS2408 at R34 - 5	
50	1-Wire relay DS2408 at R34 - 6	
51	1-Wire relay DS2408 at R34 - 7	
52	1-Wire relay DS2408 at R35 - 0	Extension board based on the DS2408 chip with 8 relays. This R33 marked board is defined at row **35** of the temperature/thermostat settings. The logic formula is the same as for open collector outputs (18 to 41 above).
53	1-Wire relay DS2408 at R35 - 1	
54	1-Wire relay DS2408 at R35 - 2	
55	1-Wire relay DS2408 at R35 - 3	
56	1-Wire relay DS2408 at R35 - 4	
57	1-Wire relay DS2408 at R35 - 5	
58	1-Wire relay DS2408 at R35 - 6	
59	1-Wire relay DS2408 at R35 - 7	
60	1-Wire relay DS2408 at R36 - 0	Extension board based on the DS2408 chip with 8 relays. This R33 marked board is defined at row **36** of the temperature/thermostat settings. The logic formula is the same as for open collector outputs (18 to 41 above).
61	1-Wire relay DS2408 at R36 - 1	
62	1-Wire relay DS2408 at R36 - 2	
63	1-Wire relay DS2408 at R36 - 3	
64	1-Wire relay DS2408 at R36 - 4	
65	1-Wire relay DS2408 at R36 - 5	
66	1-Wire relay DS2408 at R36 - 6	
67	1-Wire relay DS2408 at R36 - 7	
68	DS18B(S)20 HIGH byte 1	DALLAS / MAXIM http://www.maximintegrated.com Digital thermometers:
69	DS18B(S)20 LOW byte 1	
70	DS18B(S)20 HIGH byte 2	
71	DS18B(S)20 LOW byte 2	
72	DS18B(S)20 HIGH byte 3	

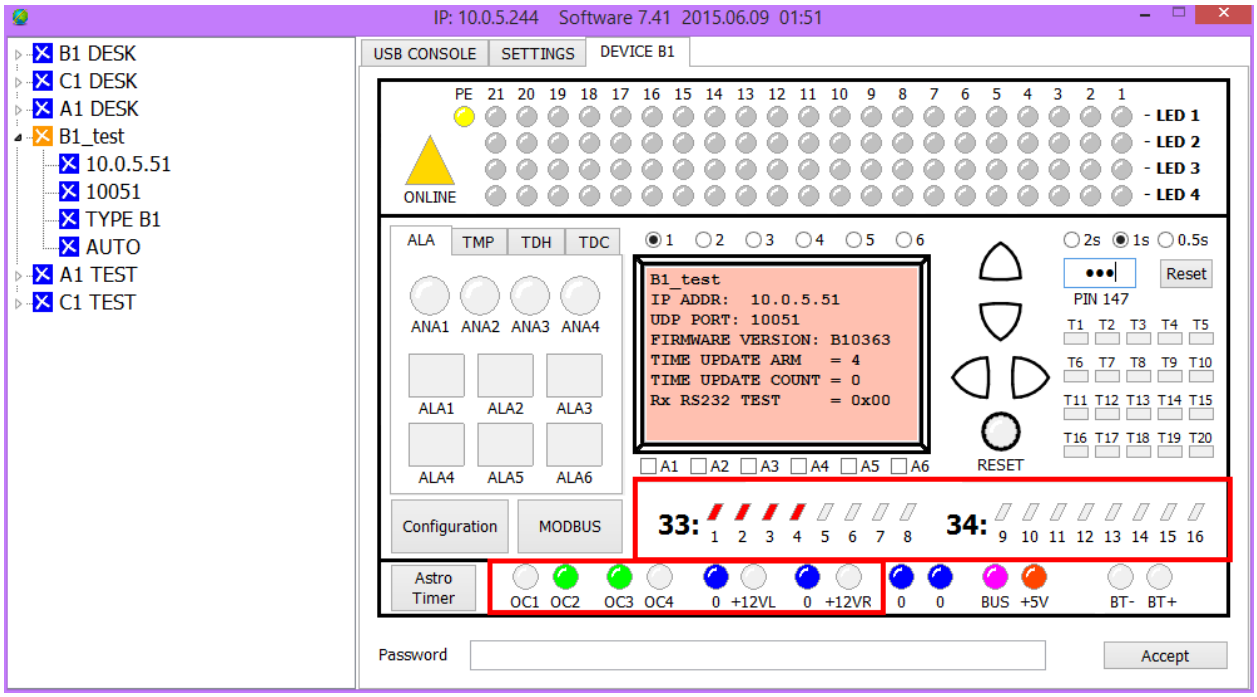
73	DS18B(S)20 LOW byte 3	DS18B20 DS18S20 DS1822 Raw temperature registers are transferred through the Modbus interface. High byte (MS byte) is transferred first followed by the LOW byte (LS byte). To obtain the temperature in degrees Celsius for the DS18B20 and DS1822 you need to divide the value in a register by 16. To obtain the temperature in degrees Celsius for the DS18S20 you need to divide the value in a register by 2.
74	DS18B(S)20 HIGH byte 4	
75	DS18B(S)20 LOW byte 4	
76	DS18B(S)20 HIGH byte 5	
77	DS18B(S)20 LOW byte 5	
78	DS18B(S)20 HIGH byte 6	
79	DS18B(S)20 LOW byte 6	
80	DS18B(S)20 HIGH byte 7	
81	DS18B(S)20 LOW byte 7	
82	DS18B(S)20 HIGH byte 8	
83	DS18B(S)20 LOW byte 8	
84	DS18B(S)20 HIGH byte 9	
85	DS18B(S)20 LOW byte 9	
86	DS18B(S)20 HIGH byte 10	
87	DS18B(S)20 LOW byte 10	
88	DS18B(S)20 HIGH byte 11	
89	DS18B(S)20 LOW byte 11	
90	DS18B(S)20 HIGH byte 12	
91	DS18B(S)20 LOW byte 12	
92	DS18B(S)20 HIGH byte 13	
93	DS18B(S)20 LOW byte 13	
94	DS18B(S)20 HIGH byte 14	
95	DS18B(S)20 LOW byte 14	
96	DS18B(S)20 HIGH byte 15	
97	DS18B(S)20 LOW byte 15	
98	DS18B(S)20 HIGH byte 16	
99	DS18B(S)20 LOW byte 16	
100	DS18B(S)20 HIGH byte 17	
101	DS18B(S)20 LOW byte 17	
102	DS18B(S)20 HIGH byte 18	
103	DS18B(S)20 LOW byte 18	
104	DS18B(S)20 HIGH byte 19	
105	DS18B(S)20 LOW byte 19	
106	DS18B(S)20 HIGH byte 20	
107	DS18B(S)20 LOW byte 20	
108	DS18B(S)20 HIGH byte 21	
109	DS18B(S)20 LOW byte 21	

110	DS18B(S)20 HIGH byte 22	
111	DS18B(S)20 LOW byte 22	
112	DS18B(S)20 HIGH byte 23	
113	DS18B(S)20 LOW byte 23	
114	DS18B(S)20 HIGH byte 24	
115	DS18B(S)20 LOW byte 24	
116	DS18B(S)20 HIGH byte 25	
117	DS18B(S)20 LOW byte 25	
118	DS18B(S)20 HIGH byte 26	
119	DS18B(S)20 LOW byte 26	
120	DS18B(S)20 HIGH byte 27	
121	DS18B(S)20 LOW byte 27	
122	DS18B(S)20 HIGH byte 28	
123	DS18B(S)20 LOW byte 28	
124	DS18B(S)20 HIGH byte 29	
125	DS18B(S)20 LOW byte 29	
126	DS18B(S)20 HIGH byte 30	
127	DS18B(S)20 LOW byte 30	
128	DS18B(S)20 HIGH byte 31	
129	DS18B(S)20 LOW byte 31	
130	DS18B(S)20 HIGH byte 32	
131	DS18B(S)20 LOW byte 32	

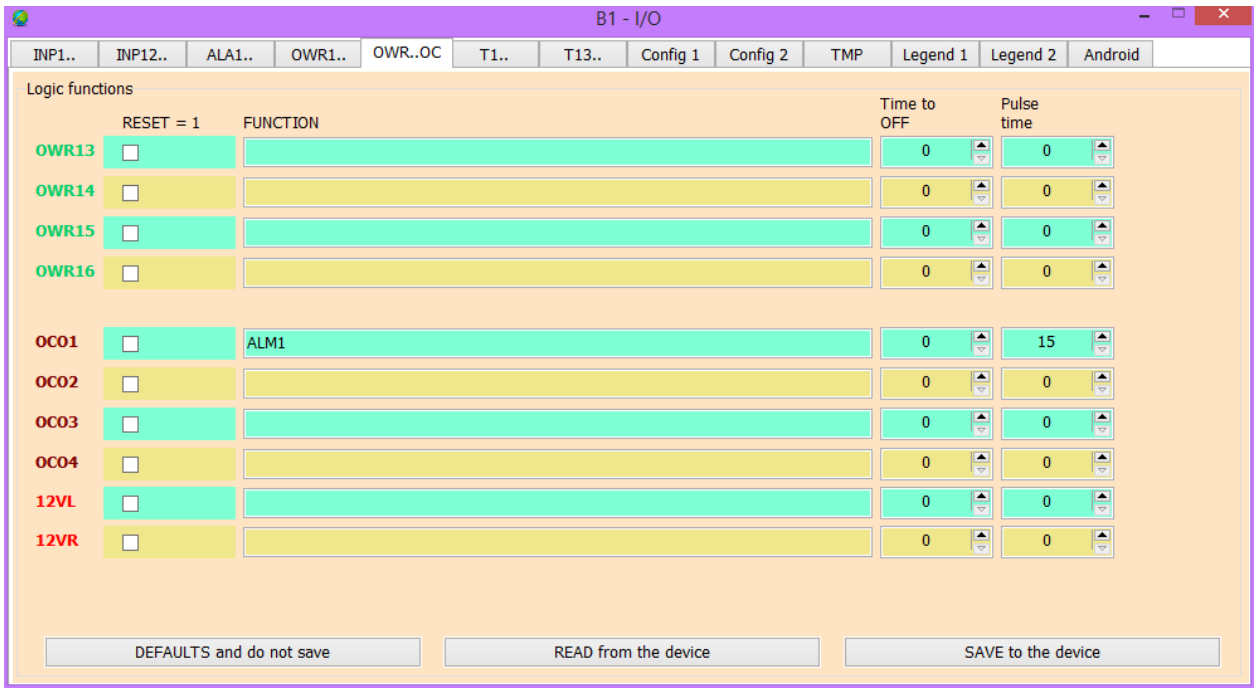
20. OUTPUTS AND TIMERS

The device has 4 open collector type outputs OC1 – OC4, 2 12V positive power outputs and optionally outputs connected with a 1-Wire bus DS2408 module.

To enter the output configuration window you need to double-click on one of the OC1 – OC4 lights, the +12VL light or the +12VR light (round icons on the bottom of the main window) or 1-Wire outputs, in the place where the mouse cursor changes to a hand.

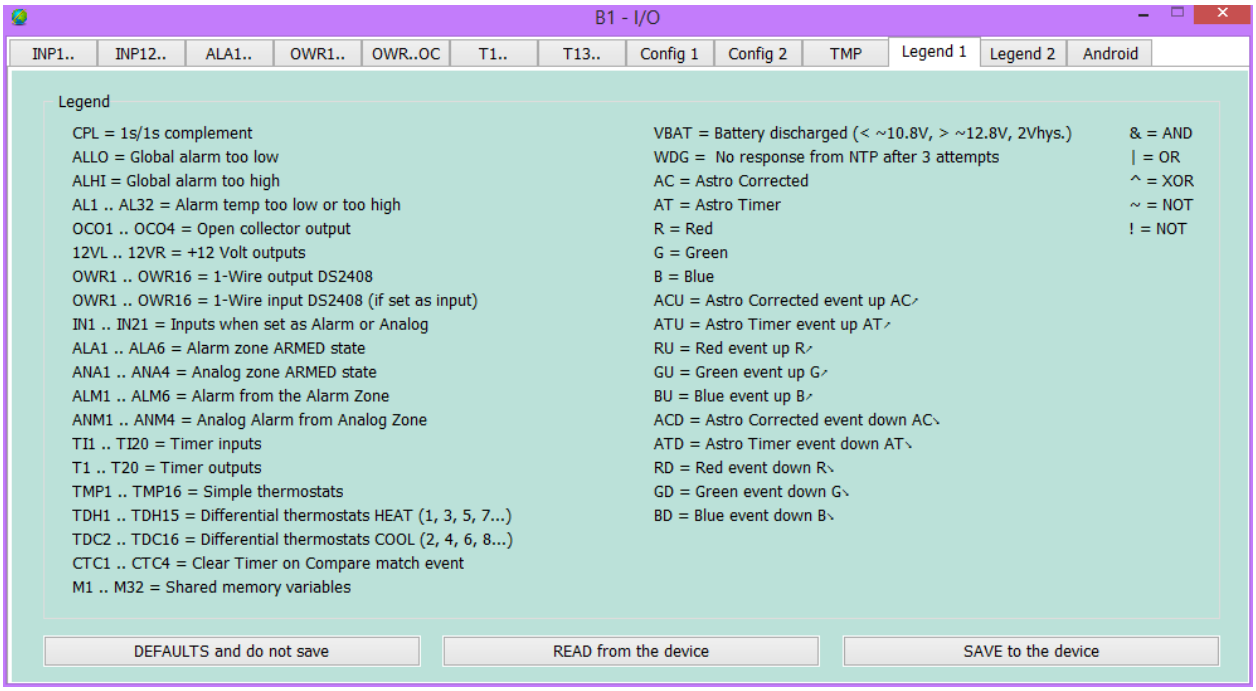


The **Output configuration** window will pop out – tabs four and five

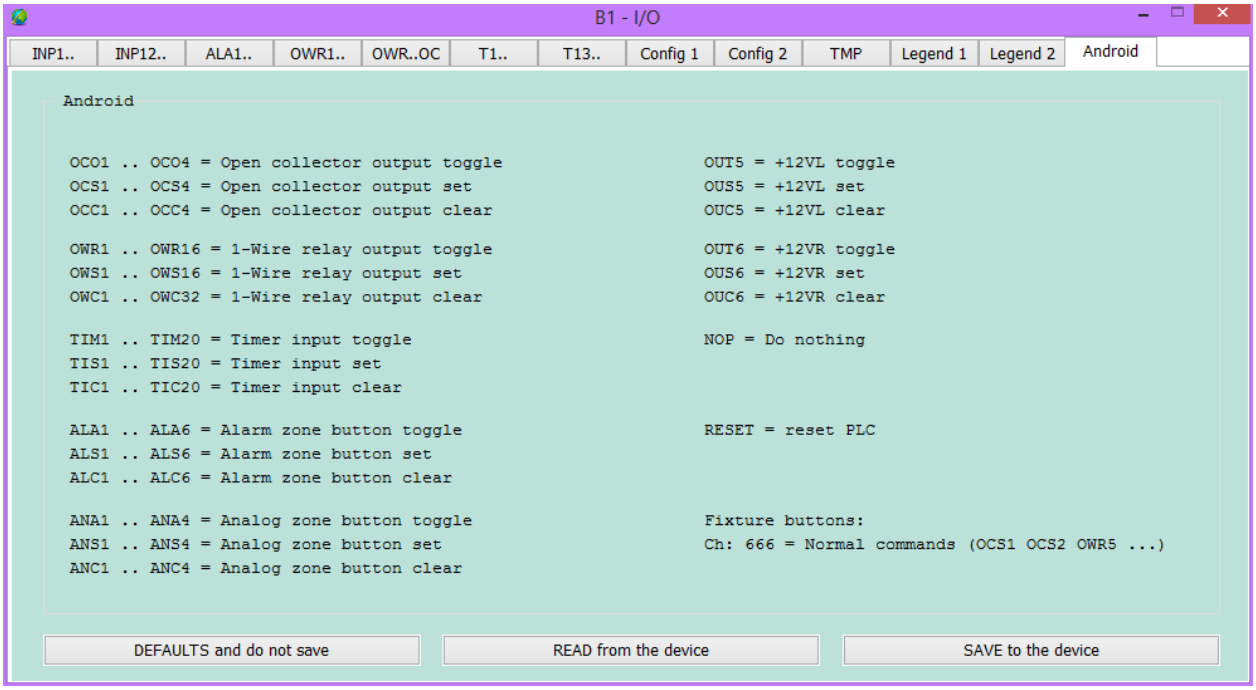


Every variable, output, thermostat, timer or memory cell can be used in the equations. The equation of one output can be a variable for another output. The maximum amount of variables in an equation line in PLC2011B1 is 6, the number of parenthesis is unlimited.

In the Legend1 tab there is a list of variable available in equations.

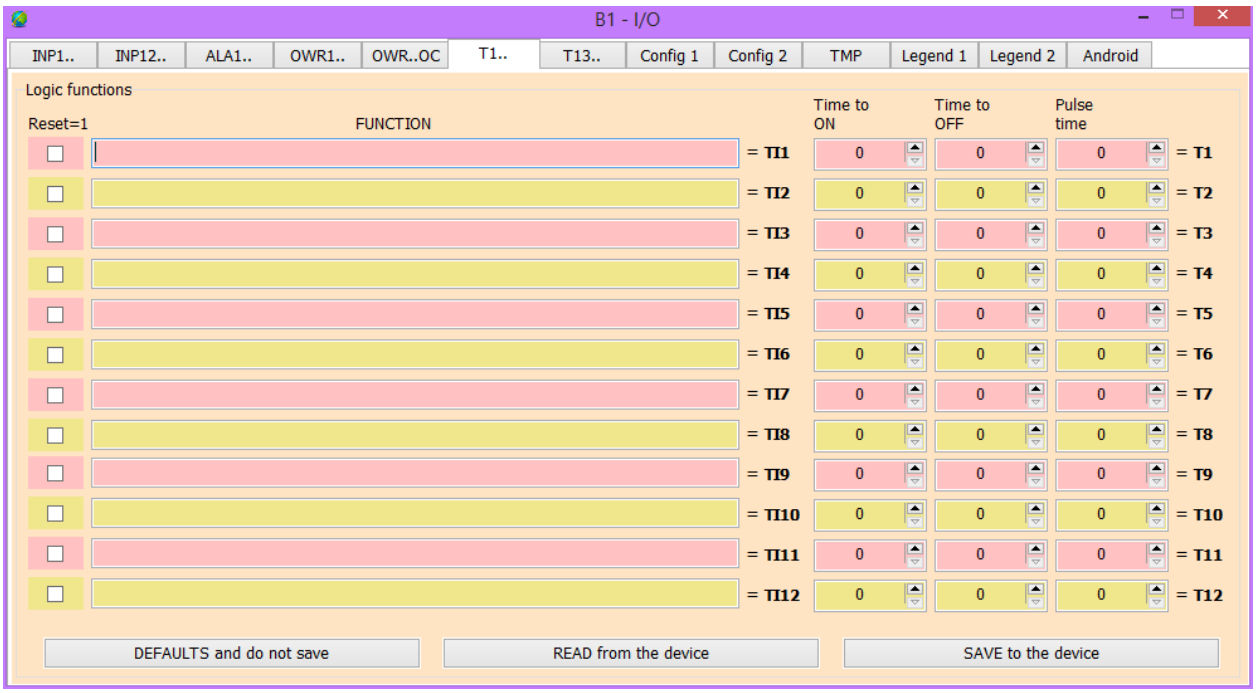

B1 - I/O
INP1..
INP12..
ALA1..
OWR1..
OWR..OC
T1..
T13..
Config 1
Config 2
TMP
Legend 1
Legend 2
Android
Legend
CPL = 1s/1s complement
ALLO = Global alarm too low
ALHI = Global alarm too high
AL1 .. AL32 = Alarm temp too low or too high
OCO1 .. OCO4 = Open collector output
12VL .. 12VR = +12 Volt outputs
OWR1 .. OWR16 = 1-Wire output DS2408
OWR1 .. OWR16 = 1-Wire input DS2408 (if set as input)
IN1 .. IN21 = Inputs when set as Alarm or Analog
ALA1 .. ALA6 = Alarm zone ARMED state
ANA1 .. ANA4 = Analog zone ARMED state
ALM1 .. ALM6 = Alarm from the Alarm Zone
ANM1 .. ANM4 = Analog Alarm from Analog Zone
TI1 .. TI20 = Timer inputs
T1 .. T20 = Timer outputs
TMP1 .. TMP16 = Simple thermostats
TDH1 .. TDH15 = Differential thermostats HEAT (1, 3, 5, 7...)
TDC2 .. TDC16 = Differential thermostats COOL (2, 4, 6, 8...)
CTC1 .. CTC4 = Clear Timer on Compare match event
M1 .. M32 = Shared memory variables
VBAT = Battery discharged (< ~10.8V, > ~12.8V, 2Vhys.)
WDG = No response from NTP after 3 attempts
AC = Astro Corrected
AT = Astro Timer
R = Red
G = Green
B = Blue
ACU = Astro Corrected event up AC↗
ATU = Astro Timer event up AT↗
RU = Red event up R↗
GU = Green event up G↗
BU = Blue event up B↗
ACD = Astro Corrected event down AC↘
ATD = Astro Timer event down AT↘
RD = Red event down R↘
GD = Green event down G↘
BD = Blue event down B↘
& = AND
| = OR
^ = XOR
~ = NOT
! = NOT
DEFAULTS and do not save
READ from the device
SAVE to the device

In the Android tab there is a list of commands for PLC2011B1 for mobile devices with Android.


B1 - I/O
INP1..
INP12..
ALA1..
OWR1..
OWR..OC
T1..
T13..
Config 1
Config 2
TMP
Legend 1
Legend 2
Android
Android
OCO1 .. OCO4 = Open collector output toggle
OCS1 .. OCS4 = Open collector output set
OCC1 .. OCC4 = Open collector output clear
OWR1 .. OWR16 = 1-Wire relay output toggle
OWS1 .. OWS16 = 1-Wire relay output set
OWC1 .. OWC32 = 1-Wire relay output clear
TIM1 .. TIM20 = Timer input toggle
TIS1 .. TIS20 = Timer input set
TIC1 .. TIC20 = Timer input clear
ALA1 .. ALA6 = Alarm zone button toggle
ALS1 .. ALS6 = Alarm zone button set
ALC1 .. ALC6 = Alarm zone button clear
ANA1 .. ANA4 = Analog zone button toggle
ANS1 .. ANS4 = Analog zone button set
ANC1 .. ANC4 = Analog zone button clear
OUT5 = +12VL toggle
OUS5 = +12VL set
OUC5 = +12VL clear
OUT6 = +12VR toggle
OUS6 = +12VR set
OUC6 = +12VR clear
NOP = Do nothing
RESET = reset PLC
Fixture buttons:
Ch: 666 = Normal commands (OCS1 OCS2 OWR5 ...)
DEFAULTS and do not save
READ from the device
SAVE to the device

20.1. TIMERS

TI (timer input) and T (timer) variables are fields of general purpose.



They can be used in any way depending on the user's creativity, e.g. as auxiliary variables. The TI variable is data before the timer. After the timer processes the data the T variable is received.

Every output can be controlled individually and remotely using the PC software or an Android mobile device. You can control each output separately, a group of chosen outputs or all of the outputs at the same time.

Available logic functions are:

"&" - AND function
"|" - OR function
"^" - XOR fuction
"~" or "!" - NOT function (both symbols can be used depending on the user's preference)

Please pay attention to the example shown in the picture above

In the TI2 you have a combination (OCO1 | OCO2 | OCO3) & AC
This means that TI2 = (OCO1 | OCO2 | OCO3) & AC as this equation was entered in the X2 field.

Please be aware of GOOD PROGRAMMING PRACTICE!!!
TI2 = (OCO1 | OCO2) | (OCO3) & AC
TI4 = T2 & OWR32
TI6 = (T4 & ~(AT))

Variable TI2 was calculated once and if similar equations were to be inserted again into variables TI4 and TI6 it would like this:

TI2 = (OCO1 | OCO2 | OCO3) & AC
TI4 = ((OCO1 | OCO2 | OCO3) & AC) & OWR32
TI6 = ((((OCO1 | OCO2 | OCO3) & AC) & OWR32) & (~AT))

This is INCORRECT!

This adds unnecessary operations for the controller as the already calculated equation must be calculated again and despite the fact that the equation itself is correct this is bad practice! Anywhere you can you should simplify the calculation process and if you have a function that is used in several places it should be calculated once and then only the calculated value should be used. It can be calculated in either one of the OCO, OWR or TI fields, the important thing is not to recalculate an already existing function.

The controlloer processes the equation fields a couple dozen of times every second in the following order:
OCO1...OCO24
OWR1...OWR32
TI1...TI20
Then returns to executing the equation from line OCO1 and that time and again.
The speed at which this happens depends on the complexity of the equations and may range from a couple of dozen cycles per sencod to only a couple cycles per second. This is why you need to pay attention to optimalization. Also the equation execution order should be considered when optimalizing the controller operation. Equation fields for unused outputs can be used as varaibles. There are no restrictions concerning the use of available resources. You can intentionally skip outputs if you intend to use their fields as variables when you need a quick reaction time and it suits you to calculate something while processing.

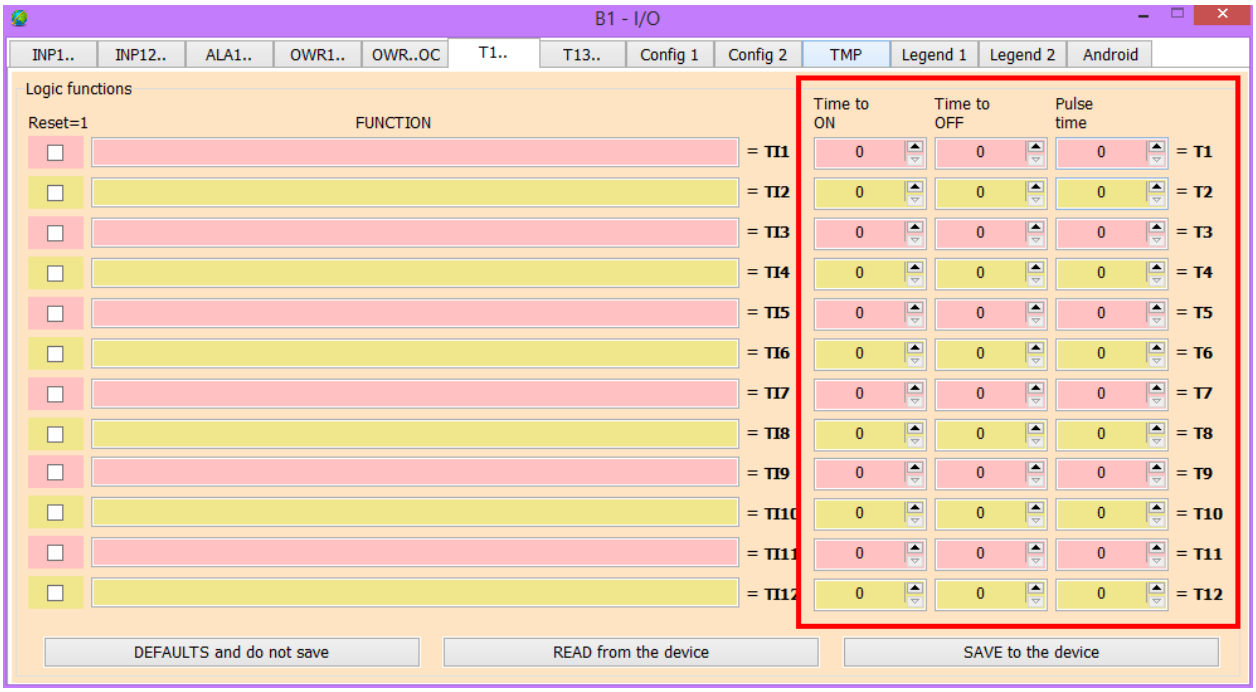
The worse you program the controller the slower it will work.

Output operation is based on events. This means that the output status will be switched to opposite only when the equation result changes. This kind of event can be annulled, the output status can be changed in any given moment. The output status is not blocked by the occurring event.

Any output can be set to the wanted status automatically after a device reset. If you check the „RESET=1” check box then the chosen output will be switched on after a reset.

An equation assigned to a timer input TI – TI20 is then processed by a time module.

For each timer there are three time modules.



- **Time to ON** – it counts time from the moment the signal appear to the moment the period of time set in this field passes. This function can be used to delay a reaction to a signal appearing. If the signal disappears before the time passes, the timer will be reset and will be ready for the signal to appear again. Only if the signal is active for a period longer that what was set the device will respond to it.
- **Time to OFF –** it works in exactly the opposite way. The loss of signal for a time period shorter than the time set will not cause the device to see the signal as inactive.
- **Pulse time** – time is counted from the moment the signal appears at a given timer to the moment the timer switches off. It means that if you set this value for e.g. 20 seconds, the timer will switch off after 20 seconds. If during this time the signal appears again, the count will be restarted. If the signal disappears before this time passes, the timer will switch off.

Example:

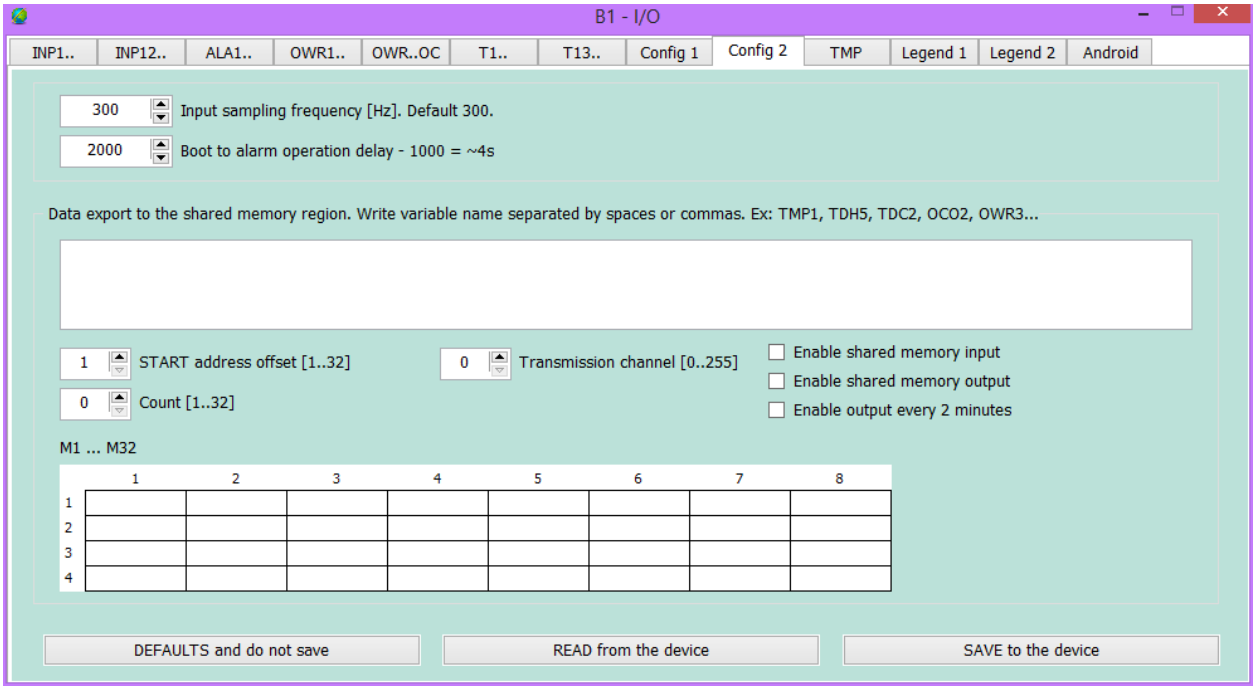
An example of how to use this settings can be a power supply outage detector with switching to auxiliary supply. If you set 10 seconds at each counter in a timer then voltage must appear for at least 10 seconds to qualify the power supply as working. Also, a loss of power for less than 10 seconds will not switch on the auxiliary power supply. The input will be invulnerable for short power losses.

21. DATA EXPORT TO SHARED MEMORY

This tab is used for settings which allow you to control other PLC2011 devices or allow the configured device to be controlled by commands from other PLC2011 devices.

To be exact, you can send out data from your device to use it to create equations in other devices or get data from other devices and use it to create equations in your device.

For this you use the **Config 2** tab.



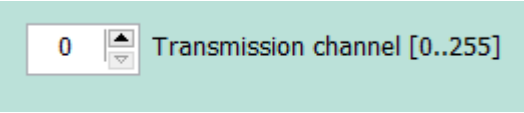
PLC2011 devices can cooperate with each other, send out and receive data from other devices. For this they used the ‘shared memory’.

A couple of conditions must be met for this function to be working.

First, the cooperating devices must have the exactly **the same password and salt** set in the main configuration (read more in the section about the password and salt).

Second, the devices must have **the same transmission channel**.

The transmission channel for the device is set in the **Channel** field. It is a value between 0 and 255.

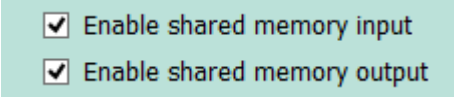


Third, the devices must be in **the same local area network**.

Depending on whether you want the device to send out or receive commands you need to set the options:

Enable shared memory input
Enable shared memory output

If you want the device to do both those things, you need to select both of these options.

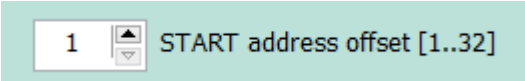


The command which you can use are the same as those presented in the **Legend 1** tab. You cannot however send out a combination of commands or an equation. Equations will be created in the receiving device using data from your device.

Entered commands will be signals from your device that will trigger a reaction in other devices. For example, if you enter INP1 into the table then the signal for other devices will be sent out when you switch on this input in the transmitting device. Also, the signal will be sent out when the input is switched off. The command will then stop being active.

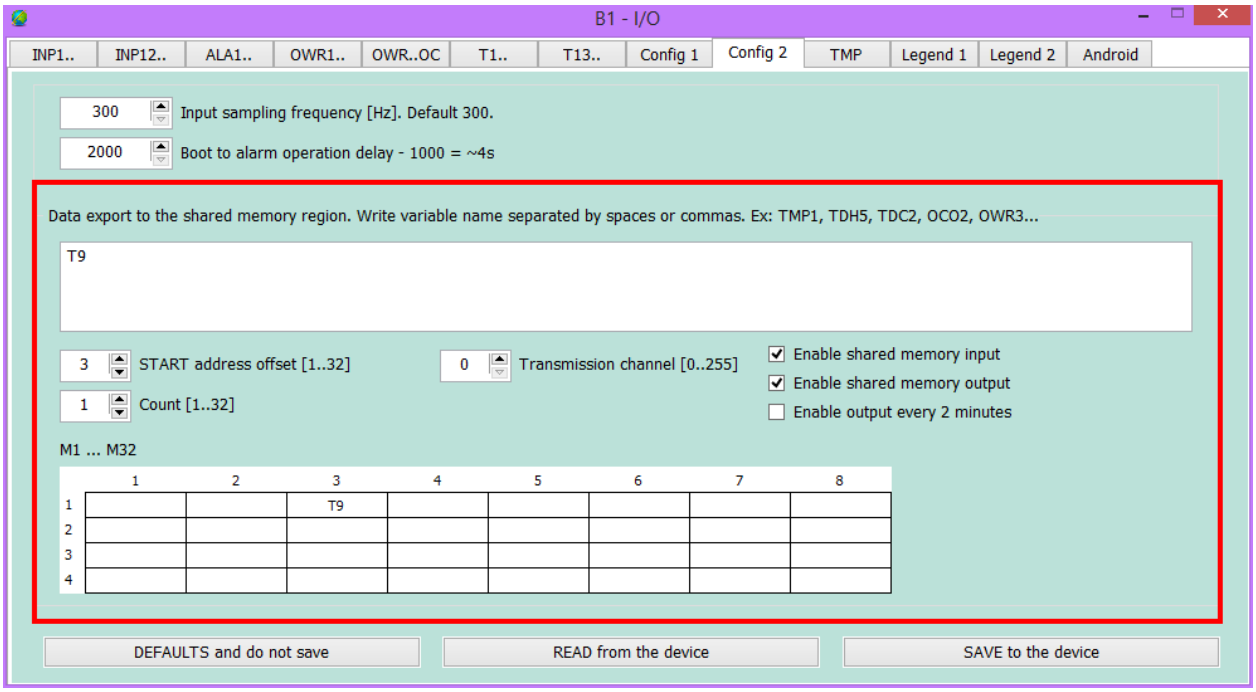
Sending out commands

First, you need to set the **Start Address Offset**. This is the place in the shared memory where you will start entering commands which you want to send to other devices.



The command table has 32 spaces (cells). This is the maximal number of commands that can be transmitted between devices on one channel. Therefor you need to pick a values between 1 and 32.

The table is the same for all cooperating devices, but at any given moment you can only see the commands coming from the device you are currently logged on to.



From your device you cannot see what variables on what addresses are sent out from other devices.

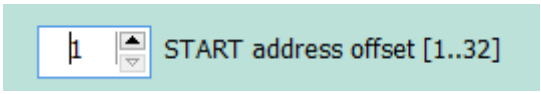
This is why you should be careful when entering commands from multiple devices. You should not enter more than one command in a single cell. This may cause unpredictable changes in how the device works.

We advise you to print out or draw a similar table and use it as a ‘cheat sheet’ where you can check what command from which device is in which cell.

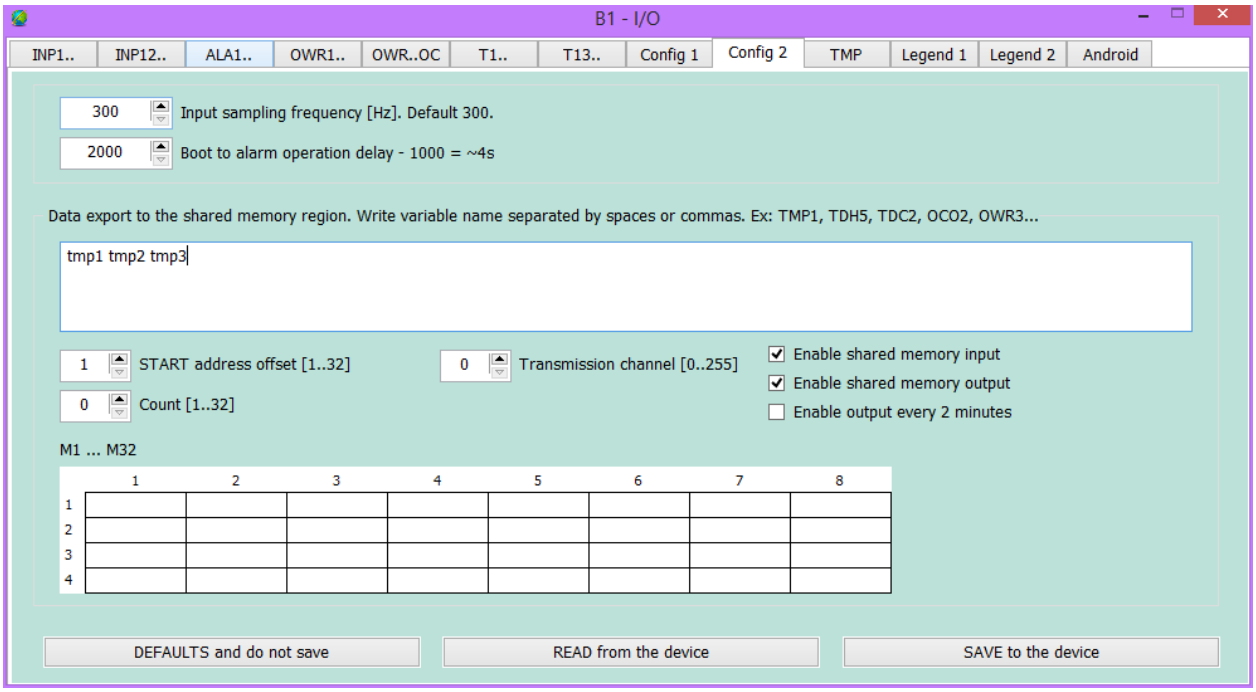
The **Start Address Offset** field is supposed to help you keep the command in the shared memory in order.

For example:

you begin to enter commands in the first device starting with address no.1

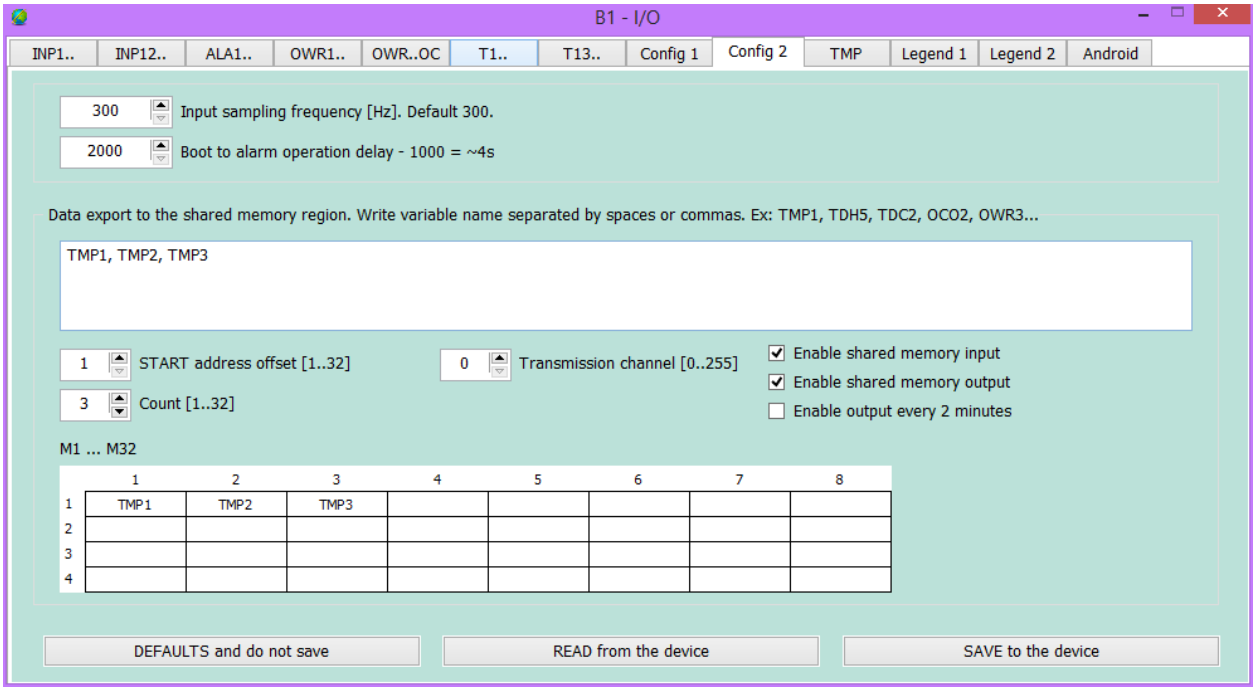


enter a string of command remembering to separate them with a signle space

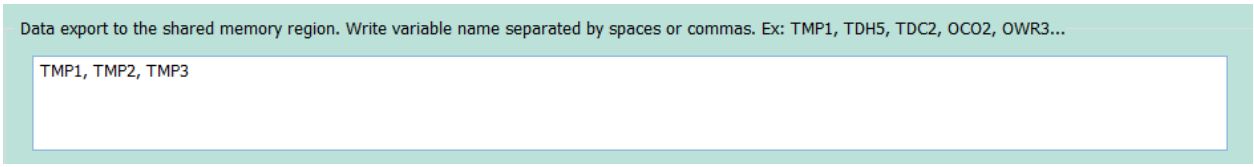


click **SAVE to the device** in the lower right corner

Before saving:

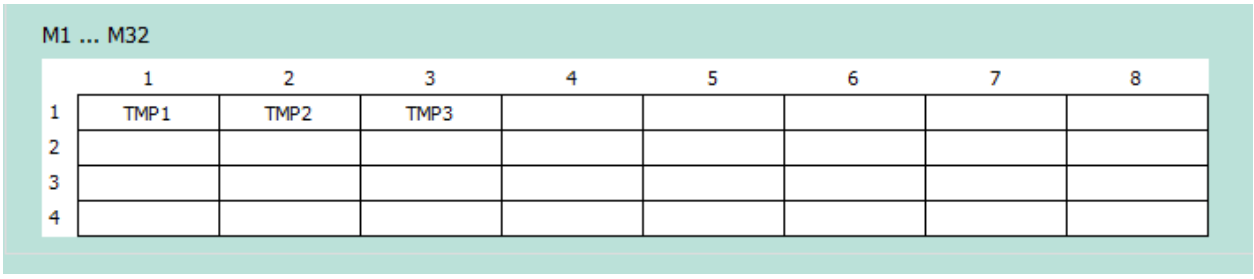


the commands will automatically be sorted and separated by comas

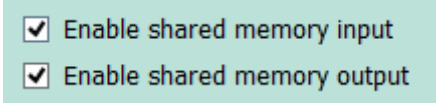

Data export to the shared memory region. Write variable name separated by spaces or commas. Ex: TMP1, TDH5, TDC2, OCO2, OWR3...
TMP1, TMP2, TMP3

the number of commands will be counted automatically

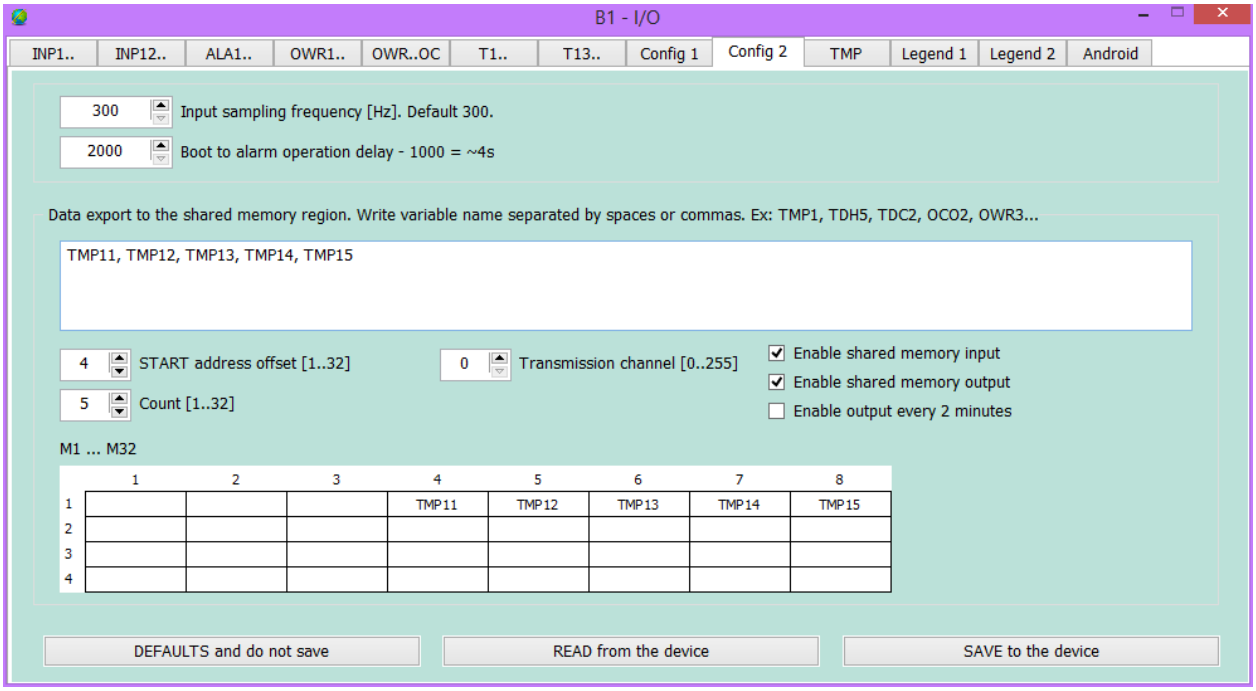
the commands will be entered in the designated cells



you must remember to switch on command transmitting and, if needed, also command reception



In the next device you need to set the **Start Address Offset** to 4 because the first three addresses are already taken and the command table will be filled from this device starting with cell no.4.



You act in a similar fashion in other devices.

How to use shared memory data

If you have a command table ready you can start to use shared memory data in equations.

How to enter this data in equations?

In the device receiving the commands you must enter it as a value from the command table, from M1 to M32.

The number depends on the cell the command was assigned to in the transmitting device.

The M1 field starts the first column of the first row. The following fields are numbered in an ascending way from left to right. The second row starts with cell M9, the third with M17 and the fourth with M25. The last cell is M32.

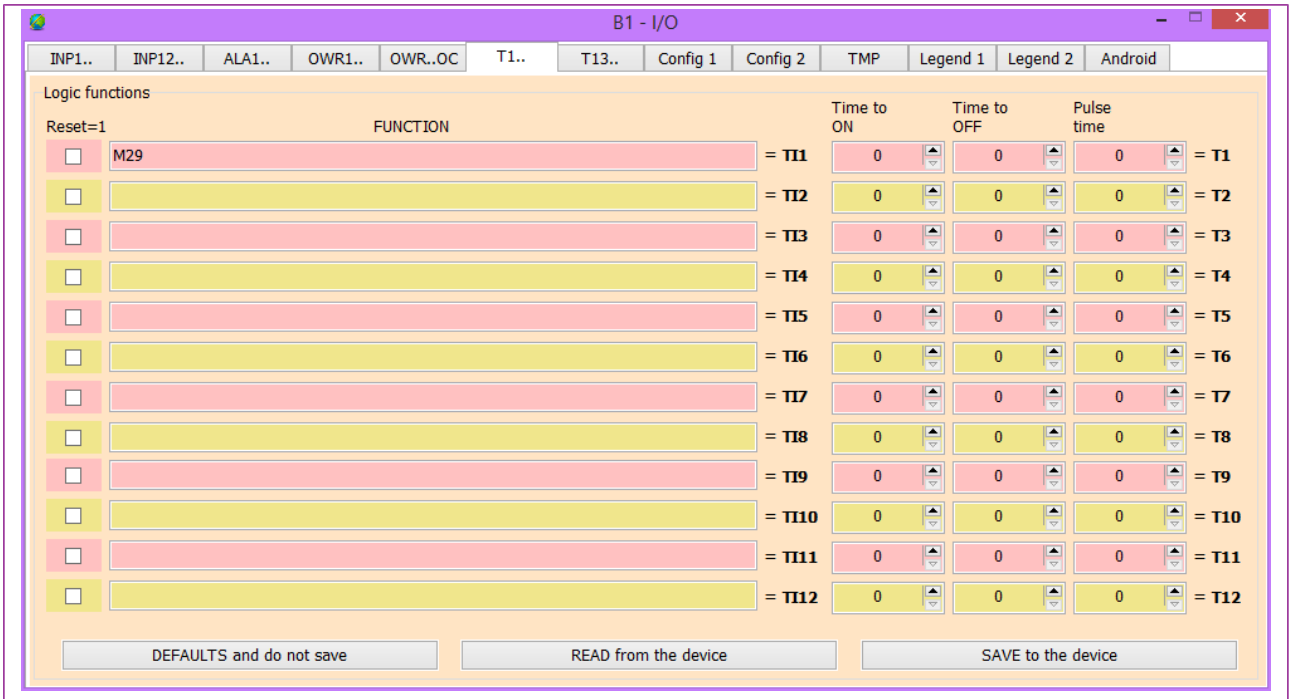
M1 ... M32

	1	2	3	4	5	6	7	8
1	M1	M2	M3	M4	M5	M6	M7	M8
2	M9	M10	M11	M12	M13	M14	M15	M16
3	M17	M18	M19	M20	M21	M22	M23	M24
4	M25	M26	M27	M28	M29	M30	M31	M32

For instance, you want to use open collector output OCO5 from one of the devices in your network and you know it is written into cell M29. This is the value you need to enter into your equations.

M1 ... M32

	1	2	3	4	5	6	7	8
1								
2								
3								
4	OCO1	OCO2	OCO3	OCO4	OCO5	OCO6	OCO7	OCO8



T1 variable activates when the result of the equation (here M29) will be 1, it means the content of the cell M29 in the shared memory will change the value.

The T1 variable will be updated only at he time when M29 cell will change its value from 0 to 1 or from 1 to 0.

What are you going to use these commands for depends solely on your creativity. The commands from the shared memory can be bound together in more complex equations or used with data from the receiving device

An advantage of the solution used in the device is that the commands are sent out to each cooperating device at the same time.

Thanks to this you avoid situations where devices receive and react to a command with delay caused by the fact that the commands were sent out to each device separately. This enables you to carry out synchronized operations in many devices at the same time.

22. ASTRO TIMER

PLC2011B1 is equipped with multichannel astronomical clock and a programmable timer.

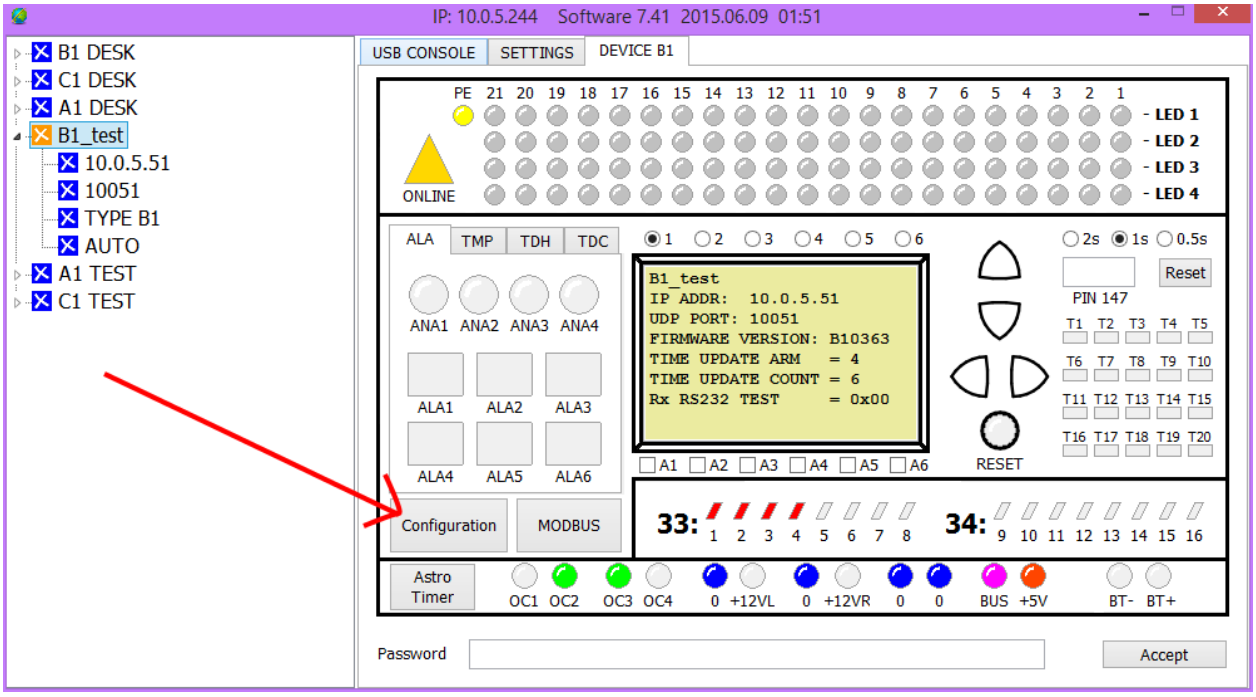
22.1. What is the astro timer for

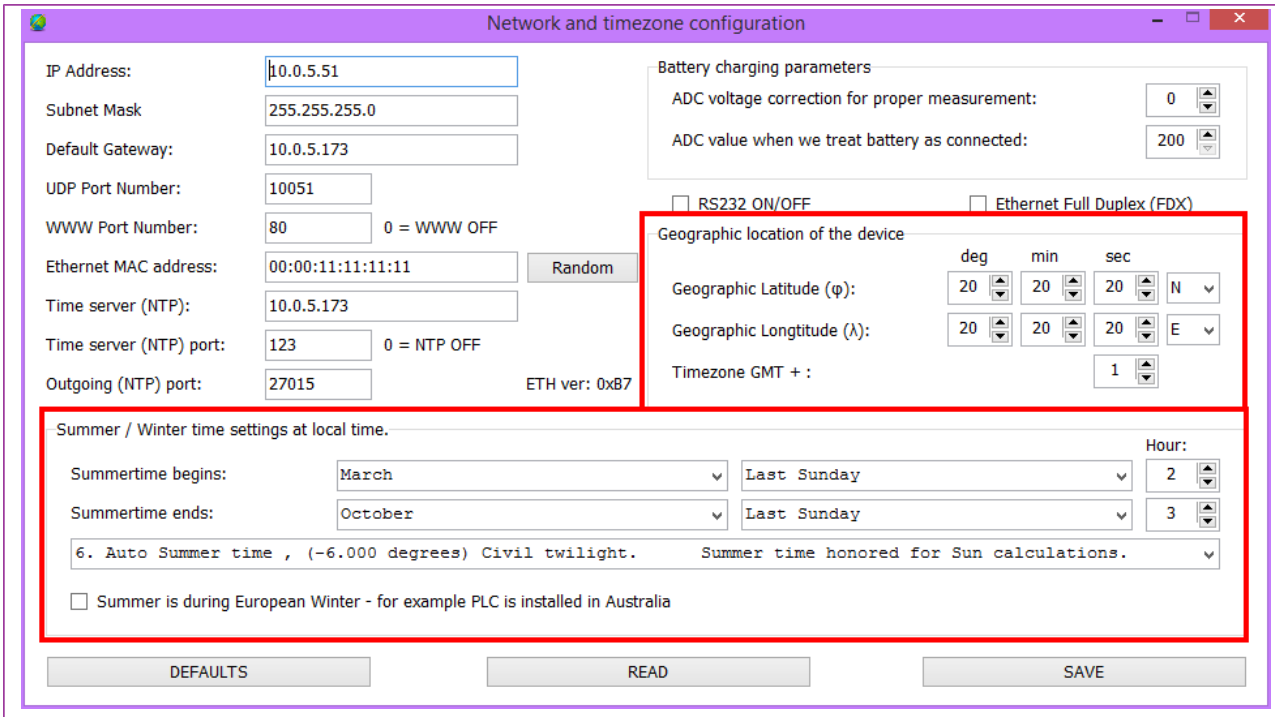
The astro timer is used to start and shut down various types of electric devices, e.g. lighting, accordingly to the daily rhythm of sunrises and sunsets for the given geographic zone. It can also block or trigger different operations during the day or at night, after sunset.

22.2. How does the Astro timer work

The Astro timer operates based on the following information:

- current date
- the device's location (geographical coordinates of the place where the device was mounted)
- time zone (time difference between the time zone where the device is used and universal time)





This information must be entered during the device's primary configuration or in our device's at any time via the computer network. Based on these information, the Astro timer switches on and off appliances connected to the device, accordingly to astronomical sunrise and sunset.

What is universal time.

Universal time (UT, UTC, GMT) – the mean solar time on the Prime Meridian at Greenwich Royal Observatory. It is the prime time zone. The time in other time zones is measured in reference to this time zone.

Time zone – a region on Earth, more or less bounded by lines of longitude, that has a uniform, legally mandated standard time, usually referred to as local time. The main 24 time zones on Earth compute their local time as an offset from UTC. Local time in each time zone is UTC plus current time zone offset for the location in question.

The Earth is split into 24 time zones.

Examples of time zones and countries within them:

- **UTC +0:00** - United Kingdom, Ireland, Portugal
- **UTC +1:00** - Germany (the local time in Germany differs by +1h from the universal time meaning that when it is 12:00 AM in a country which uses UTC+0:00, like the United Kingdom, in Germany the time is shifted forward by an hour to 13:00 or 1:00 PM), Poland, Austria, Belgium, France, Denmark, Spain, The Netherlands, Norway, Switzerland, Italy
- **UTC +2:00** - Finland, Greece, Turkey
- **UTC +3:00** - European Russia
- **UTC +8:00** - China (the whole country uses the same local time, despite its large area),
- **UTC +9:00** - Japan, North and South Korea

The United States are scattered across several time zones.

- **UTC -8:00** - West Coast, states such as California (Los Angeles, San Francisco) or Washington (Seattle)
- **UTC -5:00** - East Coast with cities such as New York or Washington D.C.

22.3. An example of how the Astro Timer can be used

The Astro timer can be used in street lighting systems, shop-window lighting systems, billboard lighting systems etc.

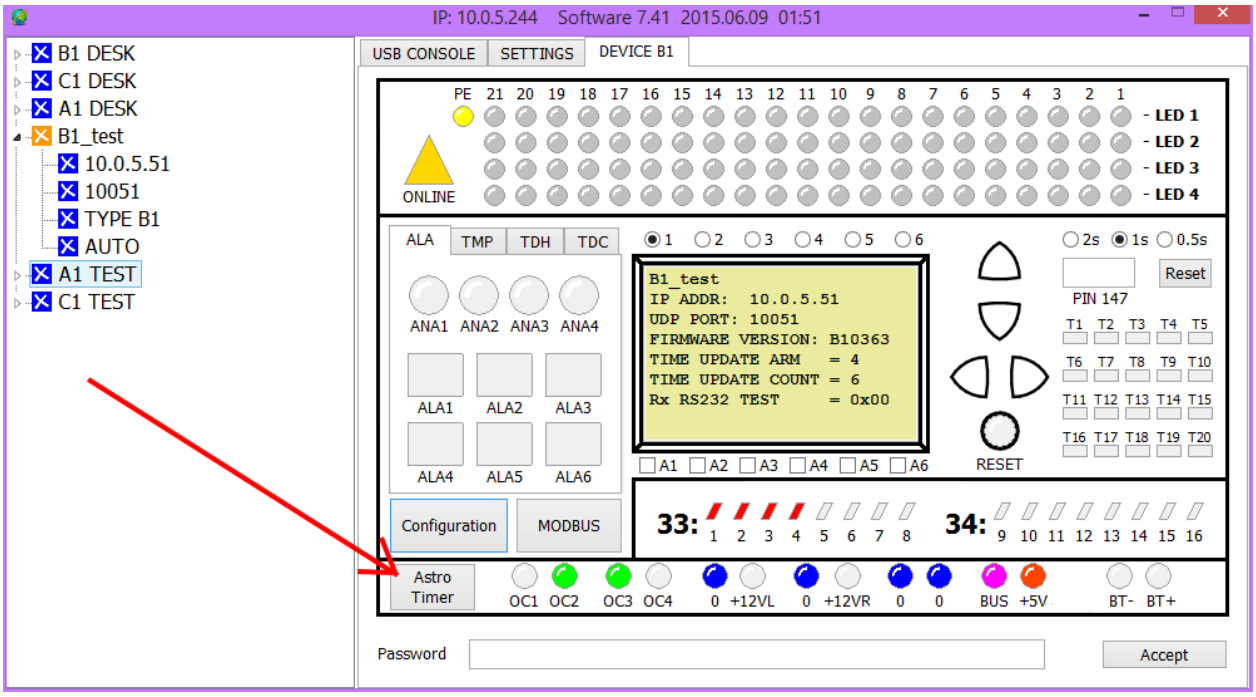
The way it works is similar to light sensors – it's task is to switch on or off the lighting on a street or square depending on the time of day. It can turn on the lights when the sun is setting and turn them off when the sun is rising and lighting is no longer required.

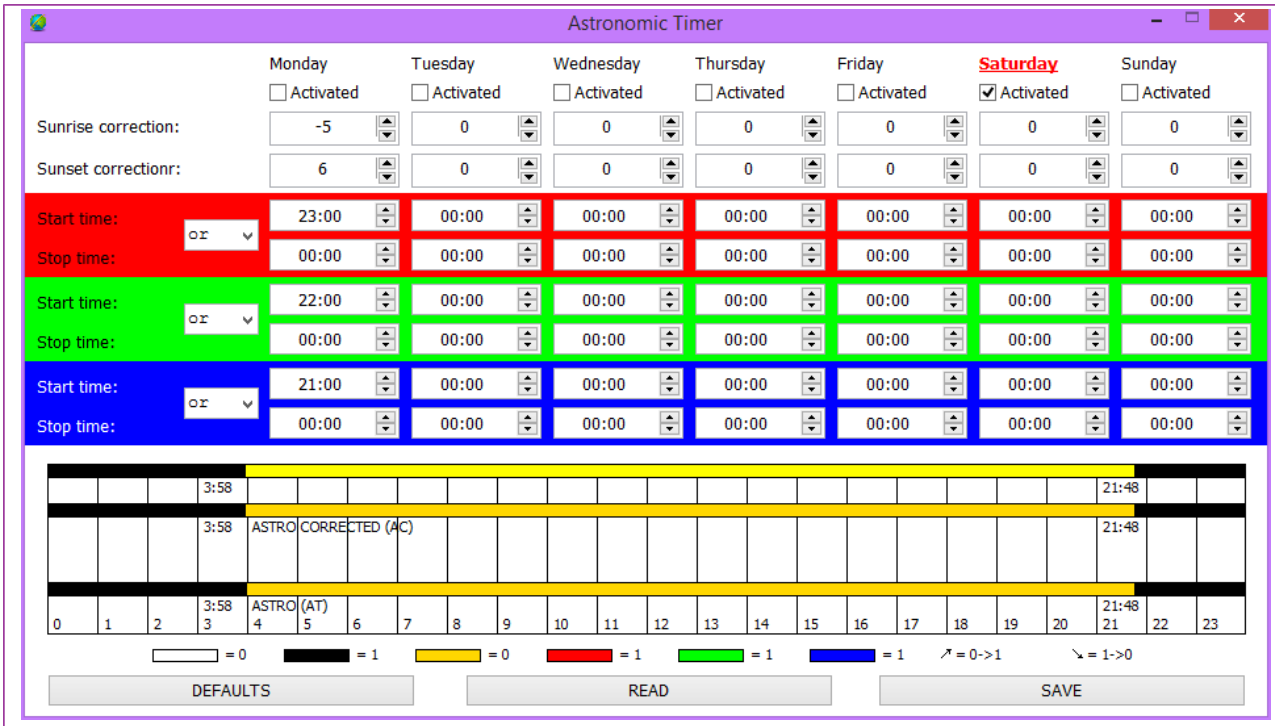
The main difference between the Astro timer and devices based on light sensors is that the Astro timer can work whether or not it is getting information about the current state of illuminance outdoors. It is also much more precise.

It can work closed in an electrical cupboard and is insensitive to factors such as high cloudiness, massive snowfall or rainfall etc. which can cause temporary darkness. Also, light sensors can get dirty which can make them malfunction. The timer calculates the time of sunrise and sunset each day and commands connected devices based on these calculations.

In the device, you can 'correct' (speed up or delay) the time of sunrise and sunset.

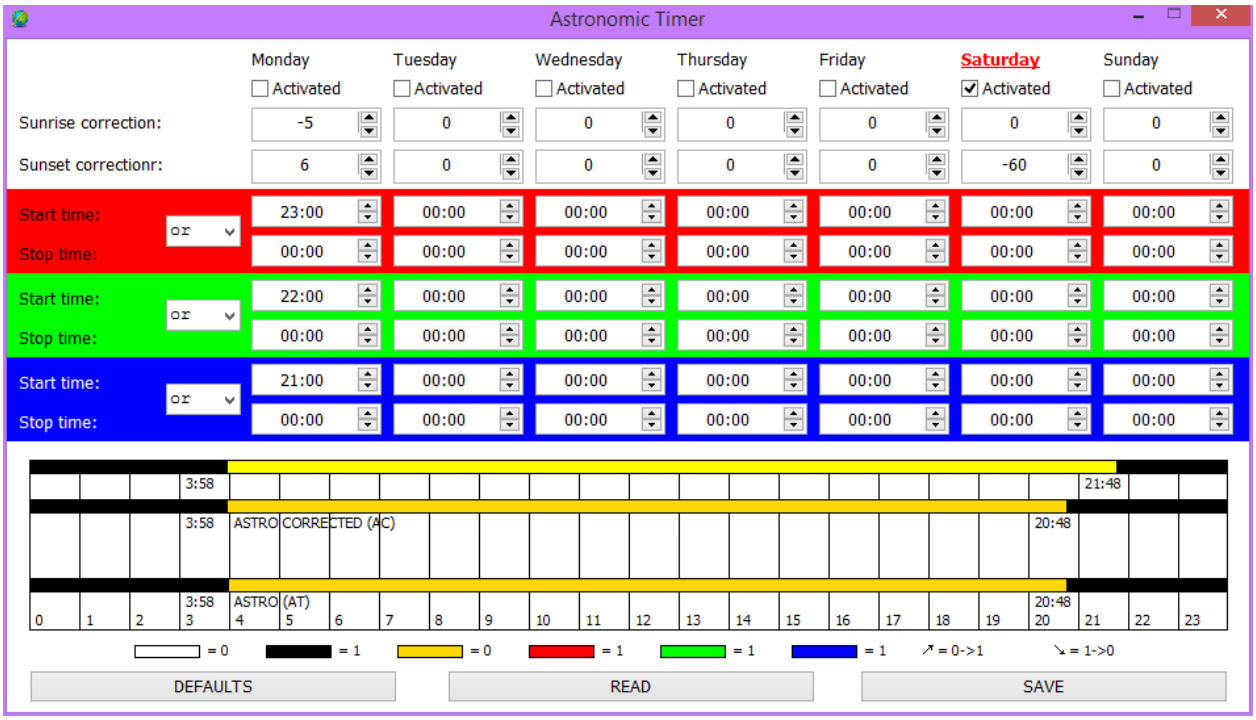
What does this mean?
Look at the example below.





- Sunset is at 09:48 P.M.
- you want the lighting outside your house to switch on about an hour before sunset when it's beginning to get dark

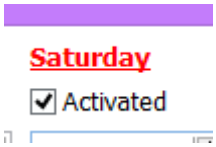
- → correct the sunset time by -60 minutes (08:48 P.M.)
- → your device will switch on the lighting 60 minutes before sunset
- → the corrected time will of course be different every day, the actual sunset time will always be corrected by -60 minutes



How do you do it?

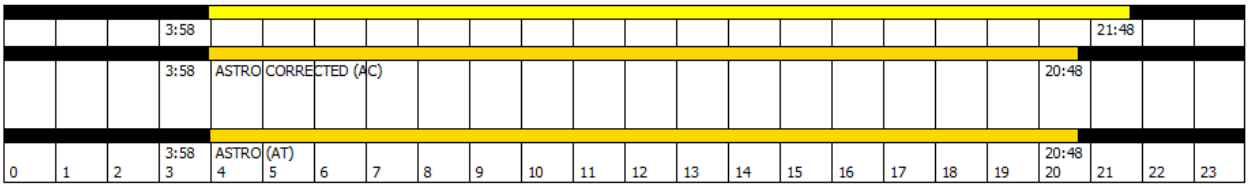
Assume that:

- today is Saturday – the current day of the week is always highlighted in red

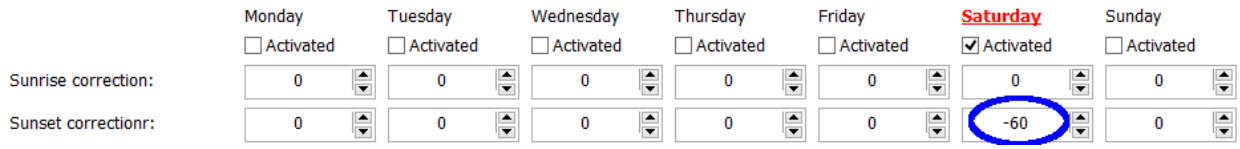


For the device to work on a given days schedule you need to check the '**Activated**' check-box (single click). Otherwise the commands for this day will not be executed.

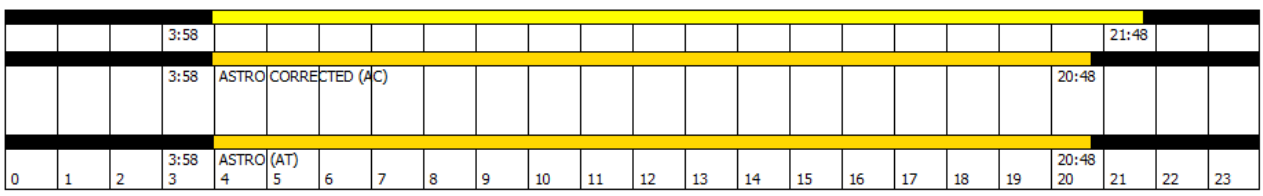
- Sunrise and sunset times are calculated by the device for the given day are marked on the first horizontal axis under the timer – yellow is the period of time between sunrise and sunset, the day and black is the night



- in this example, the sun sets at at 09.48 P.M.
- You want the lighting to turn on an hour earlier, so you must correct the sunset time by -60 minutes
- You correct the sunset time in the 'Sunset correction' box
- You set this value individually for every day
- You either enter the desired values yourself or use the arrows
- The available range is from -128 minutes to +127 minutes
- In the picture, the box where the sunset time on the current day (Saturday) was corrected by -60 minutes is marked in blue



- settings of the timer after the correction are visible on the second horizontal axis under the timer



- You see that the sunset time was moved back 60 minutes and is now at 8:48 P.M.

- If you correct the time using arrows you will see on the corresponding axis how the time changes on-the-fly
- The effect of this operation will be that your lighting will switch on an hour before sunset

22.4. TIMER function – Night Breaks (Night Intervals)

The device also has a **programmable timer** that cooperates with the Astro timer. Using this timer you can set for every day of the week three periods of time when the Astro timer will stop working.

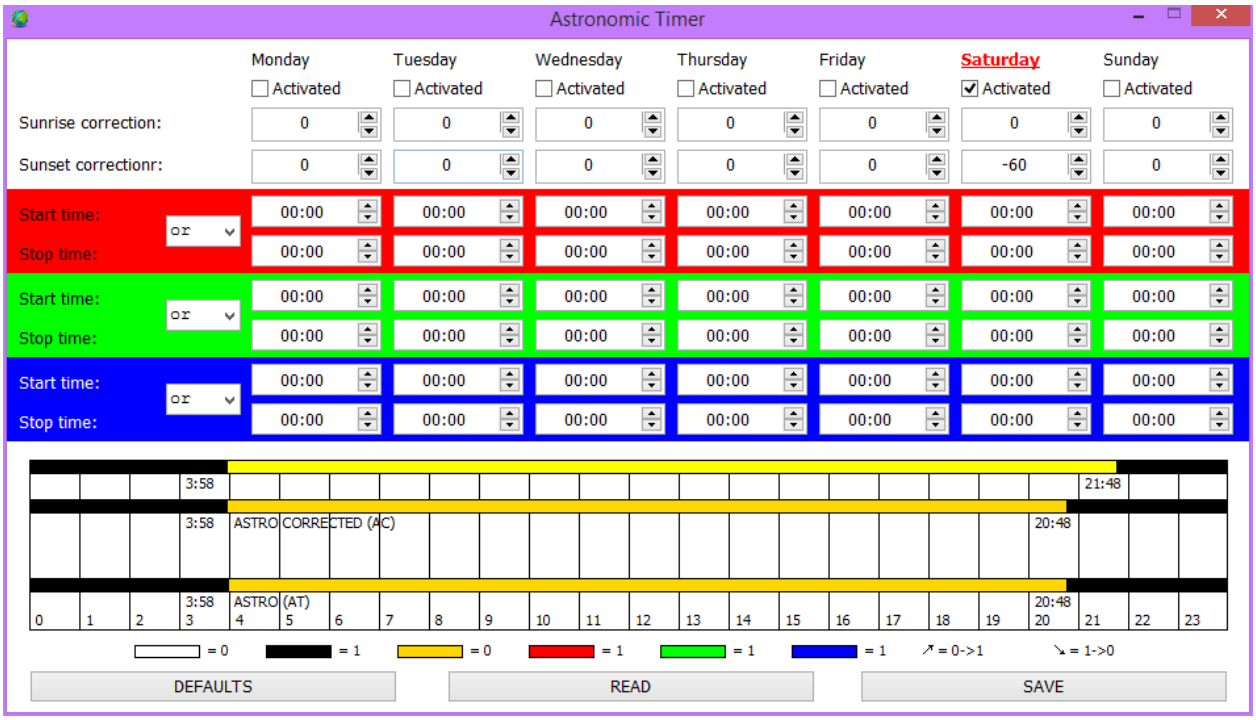
This function is often called a '**Night Break**' as you usually use it during the night when despite the fact that it is dark outside you turn off the lighting to save energy. You can also use during the day when you want to turn the lighting on for a period of time even after sunrise.

How does this work?

- The Sun sets at 9:48 P.M.
- you turn on the lighting outside your house an hour before sunset (Astro Corrected) at 8:48 P.M.
- The lighting is no longer necessary when you go to sleep after 11 P.M.
- The next day you wake up at 4:45 A.M. and you want the lighting to switch on in that moment and stay on until it is no longer dark outside
- you turn off the lighting during the time you go to sleep

How do you do it?

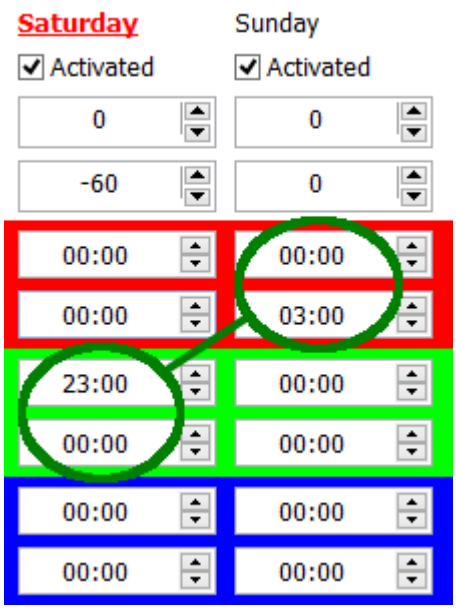
- In the middle part of the 'Astro timer' window there is a timer.



- For each day you can set three periods of time where the way the Astro timer works will be modified
- Each of these periods has two fields:

  ➔ 'Start time'
  ➔ 'Stop time'

- In the first of the fields enter the time you want the break to start, in the second the time you want it to end



- In this example the devices task is to turn on the lighting after sunset, so reversing that function will turn the lighting off
- Go to the current day in the timer window

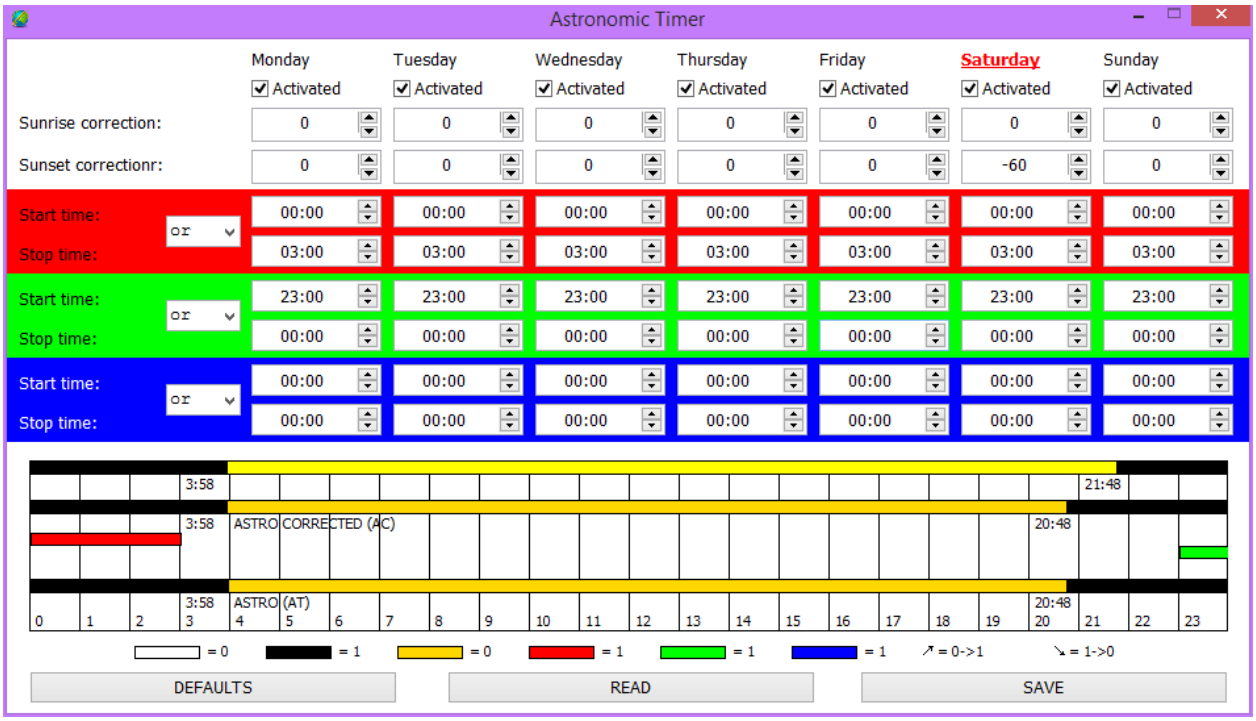
- First pick the time you want the 'break' to start
- In the 'Start time' box, set 23:00 (11:00 P.M.) using the arrows or typing it in
- In the 'Stop time' you should enter 3:00 (A.M.) but since the break starts one day and ends the next day you need to 'divide' the break into two parts
- The first part of the break should be 23:00-00:00 (11-12 P.M.) of the current day (Saturday)
- The second is 00:00-03:00 (12 P.M. - 3:00 A.M.) the next day (Sunday)
- The device will smoothly switch from Saturday to Sunday merging the two parts into one

- **Remember to check the 'Activated' check-box for both Saturday and Sunday!**

The results of the settings done so far are:

1. The lighting switches on an hour before sunset
2. It is on until 23:00 (11 P.M.)
3. At 23:00 (11 P.M.) switches off automatically
4. The lighting stays off until 3:00 (A.M.) the next day
5. At 3:00 (A.M.) the lighting switches on again.
6. It stays on until sunrise.
7. At sunrise the lighting switches off

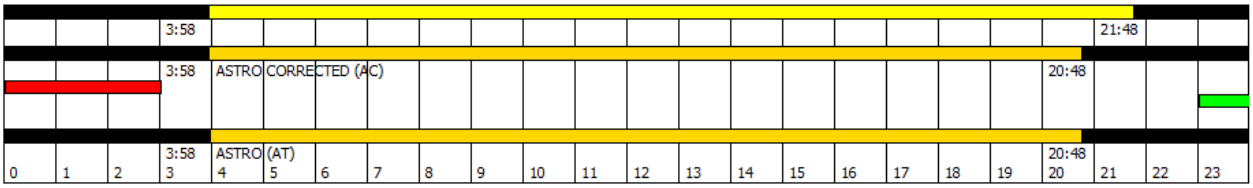
You can of course apply these settings for the whole week:



Remember to check the 'Activated' check-box for every day of the week.

BREAKS – some additional information

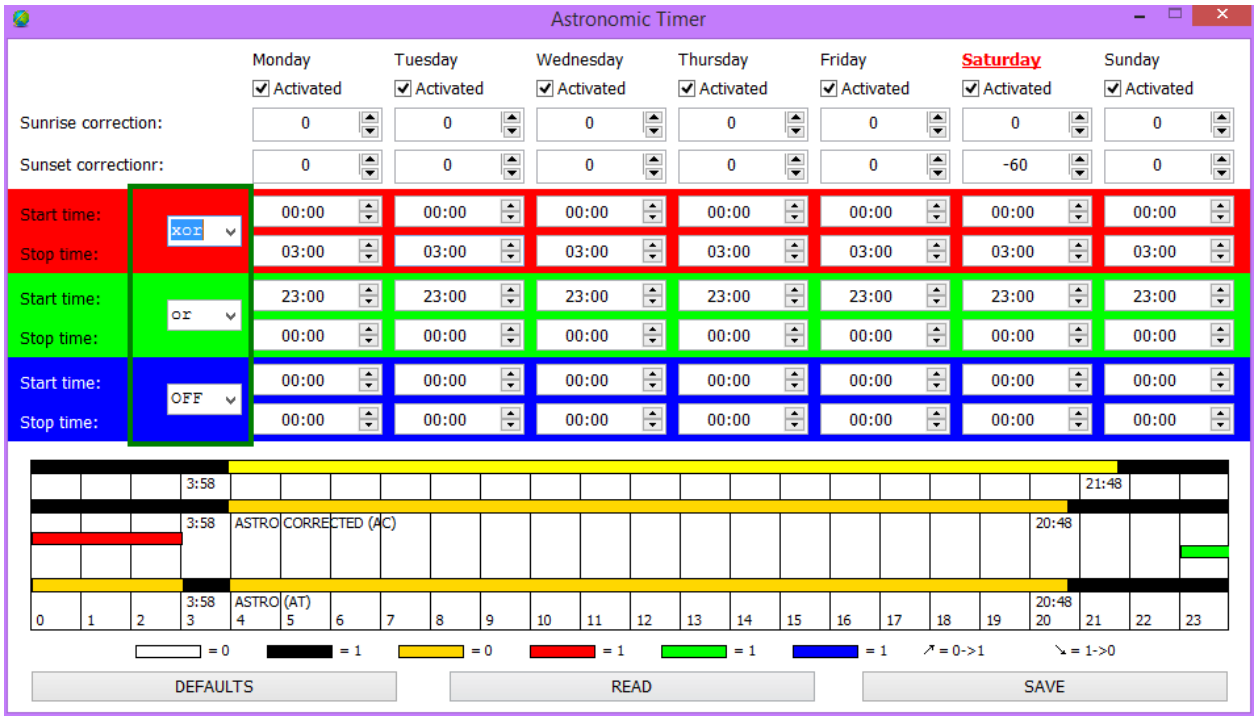
- for every day you can set up a maximum of 3 breaks
- the breaks do not have to be entered in a chronological order – the software will sort them by itself
- the settings are visible on the diagram below the timer bar.



- the red and green parts are the breaks you set (if you set a third break it will be visible in blue)
- the settings on the diagram are for the current day, below you see that the day starts with a break until 03:00 (3:00 A.M.) and ends with a break starting at 23:00 (11 P.M.)
- the diagram for Tuesday ends at midnight and if you want to see Wednesday's diagram you need to click on the word 'Wednesday' above the main part of the timer. You will then see the second part of the break you planned for Tuesday/Wednesday night.

The last axis shows the result of merging the settings of the Timer and the Astro timer after correction.

The result depends on what **logical operator** you use to connect the corrected Astro timer settings with the timer settings.



Astro timer

- **logical value 0 – yellow field on the axis**
- **logical value 1 – black field on the axis**

Timer

- **logical value 1 – when on (red, green or blue field)**
- **logical value 0 – when off (no bar, empty field visible)**

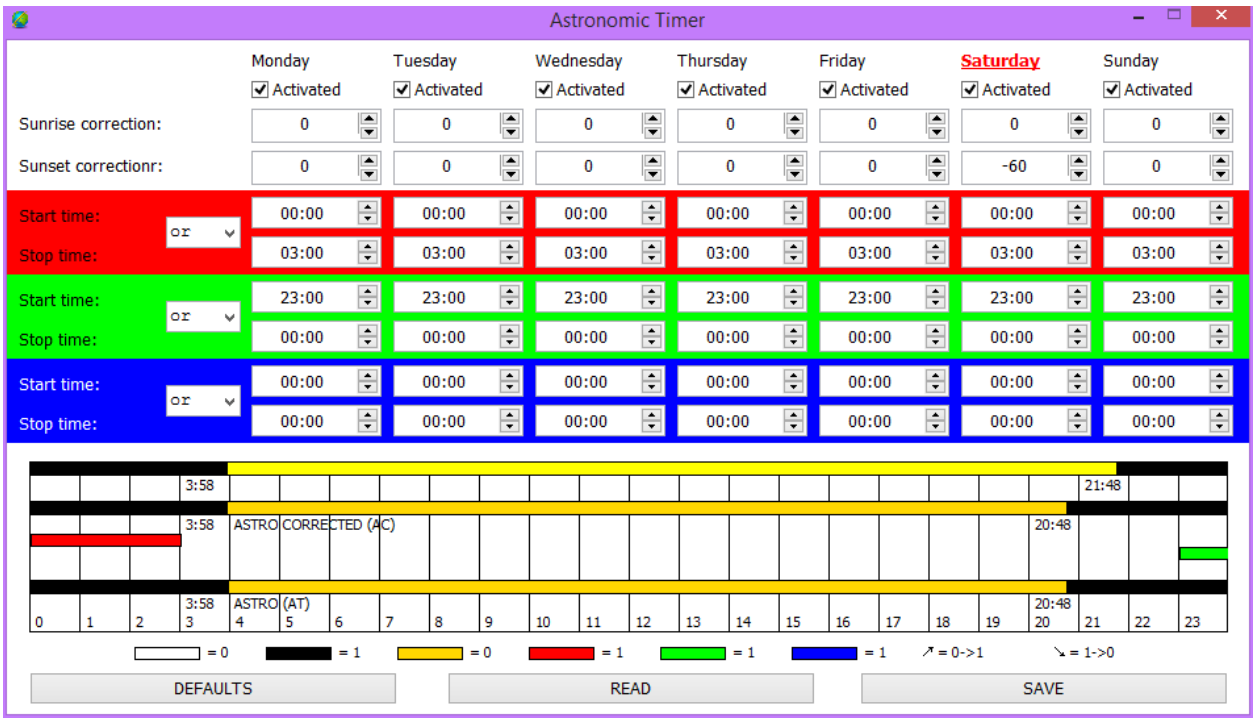
Logical operators:

- **OR** (can be called as 'alternative') – logical value 1 will be achieved if either the timers or the Astro timer logical value is 1 or both of their's logical value is 1 at the same time.

How the OR logical operator works

Astro timer	Timer	Result
0	0	0
0	1	1
1	0	1
1	1	1

Example:

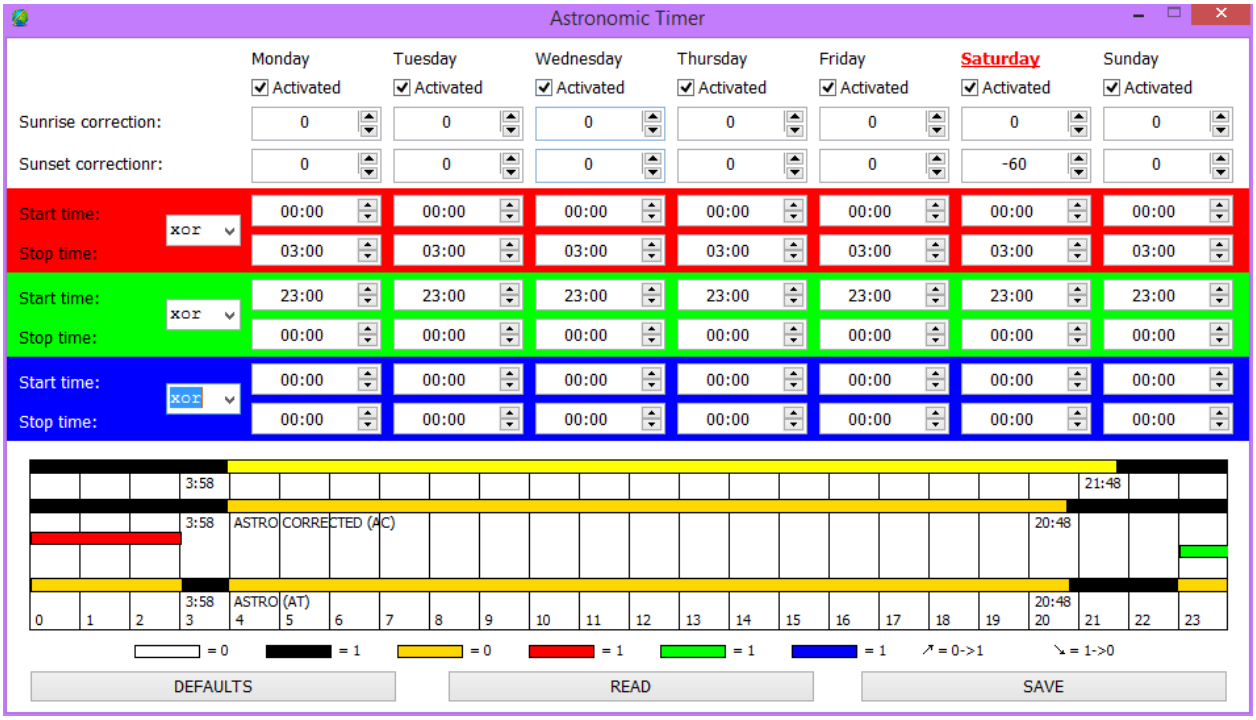


- **XOR** – logical value 1 will be achieved if the logical values on the timer and the Astro timer are different from each other

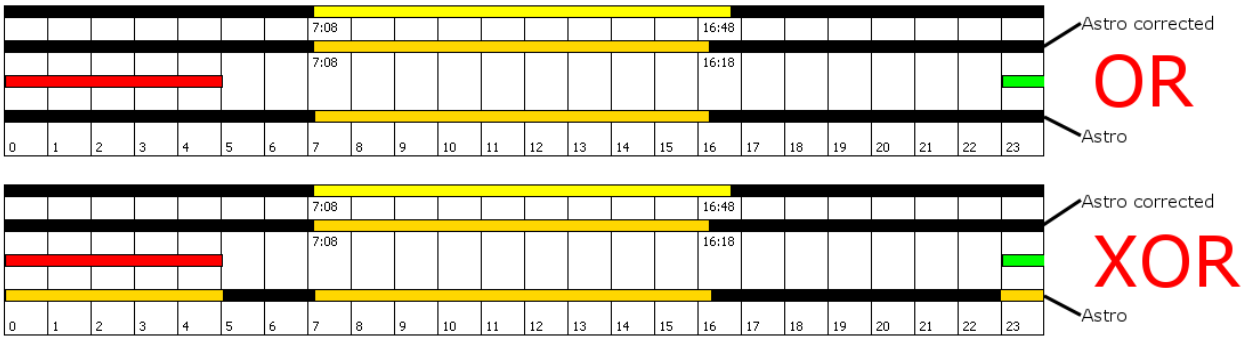
How the XOR logical operator works

Astro timer	Timer	Wynik
0	0	0
0	1	1
1	0	1
1	1	0

Example:



Comparison



On the picture above:

- **ASTRO CORRECTED** – name of the variable used in the input's logic functions
- **ASTRO** – name of the variable used in the input's logic functions (the result of logic operations between ASTRO CORRECTED and the Timer)

The **OR** function will change it's logical value from 0 to 1 but not the other way around.

The **XOR** function will change it's logical value as the timers value is always 1

Logical functions do not occur during breaks between the timer's periods of work. The corrected Astro timer is not processed and is simply copied to the lower axis.

If the color on the lowest axis is yellow it means that during that period of time the value of the logical operator is 0.

If the color on the lowest axis is black it means that during that period of time the value of the logical operator is 1.

Only the values seen on the lowest axis, obtained as a result of a logical function between the timer and the Astro timer are passed on to be used by the relay if the 'ASTRO' function is on.

Setting the OFF function for a chosen timer causes it to not be taken into account when calculating the logic result between the Corrected Astro Timer ASTRO CORRECTED and other Timers – the result is shown on the last axis.

If you use the 'ASTRO CORRECTED' function, the values further processed by the relay are the values on the second axis as that is where the relay takes data for processing from.

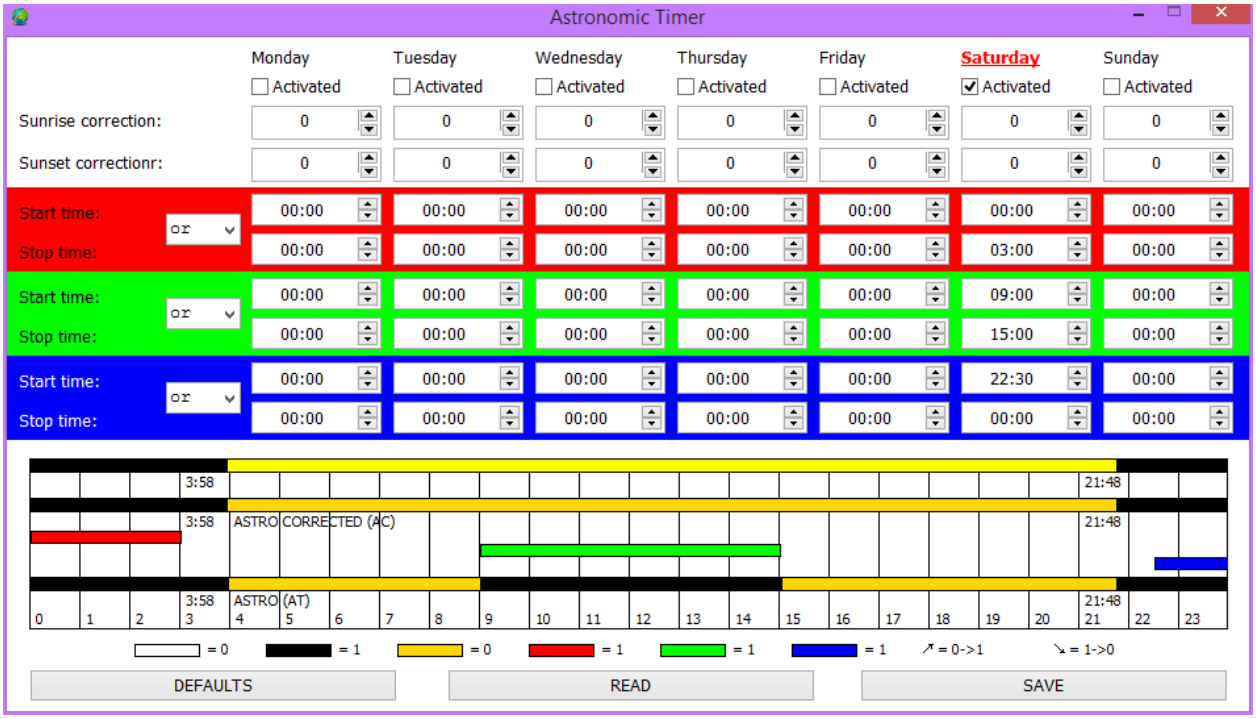
A new option was added in the newest firmware versions

You can also set the relay to process the values from the third axis which represent the hours of the so called 'night breaks'.

Descriptions

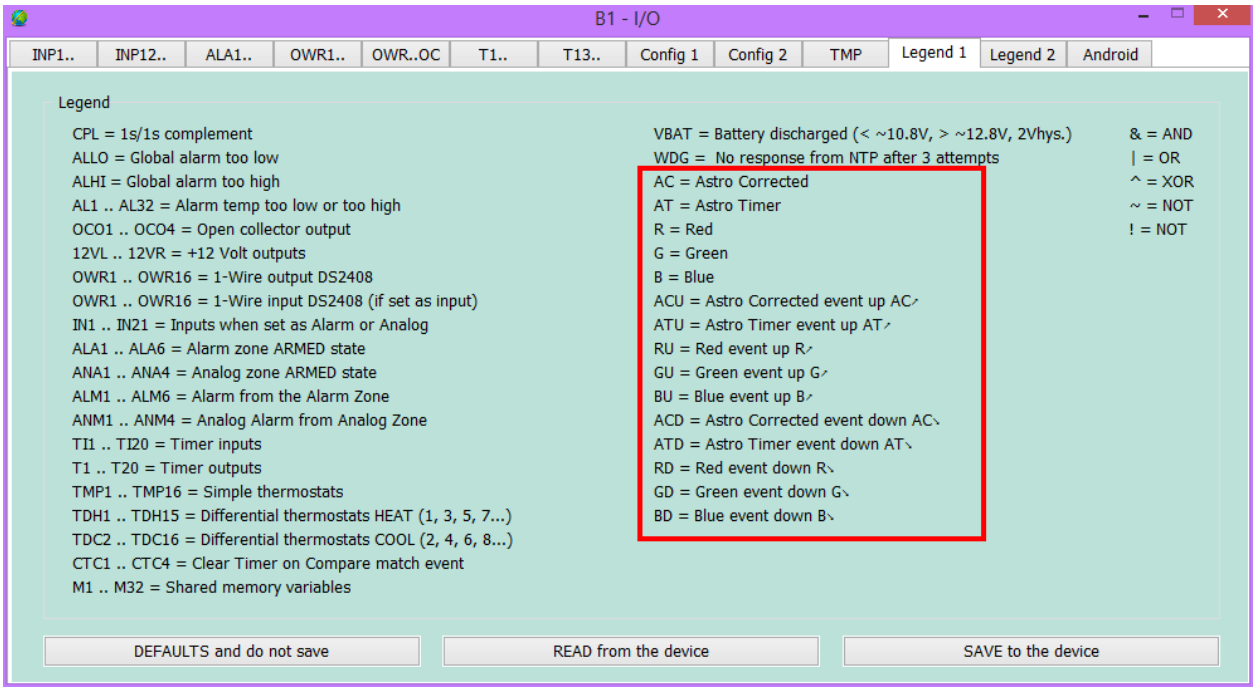
- R – red bar (RED)
- G – green bar (GREEN)
- B – blue bar (BLUE)

These bars are the so called 'night breaks', the first one of which is red on the diagram, the second one is green and the third is blue, which is why they are described as R, G and B.

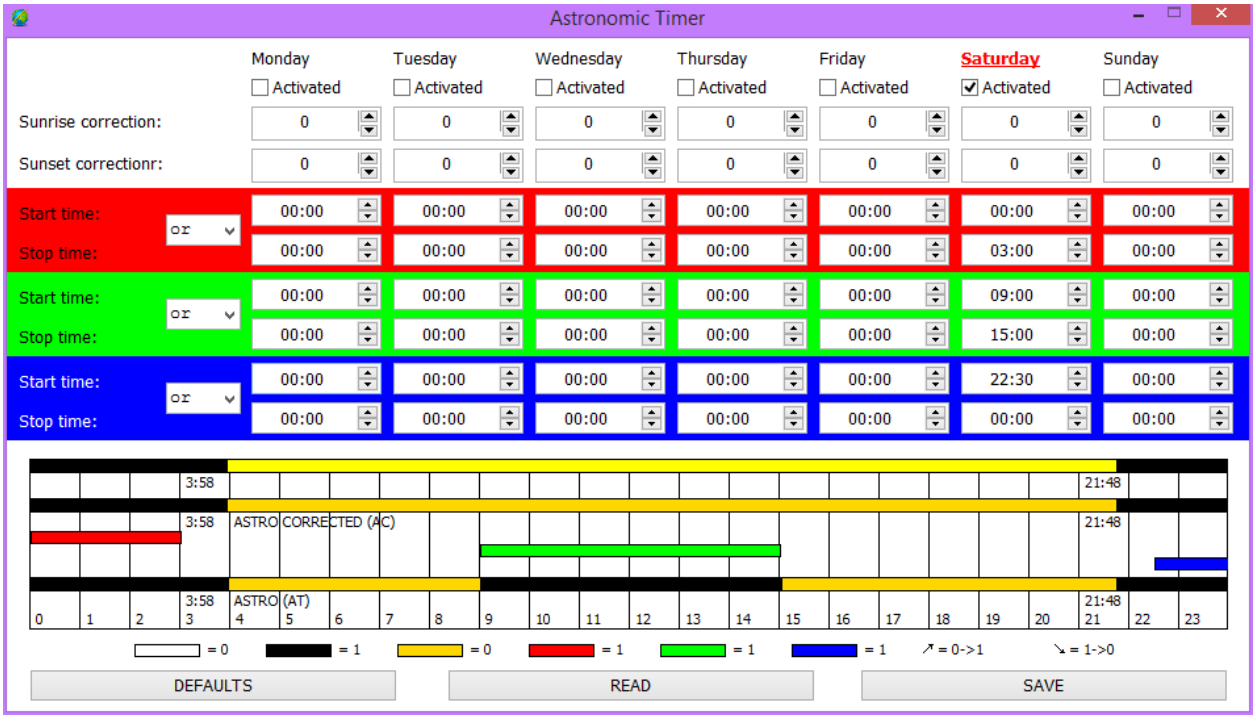


22.5. How to use the Astro timer with PLC2011B1

Variables coming from the Astro Timer can be used anywhere you have the option of entering an equation – a list of these variables is in the **Legend 1** tab.


B1 - I/O
INP1..
INP12..
ALA1..
OWR1..
OWR..OC
T1..
T13..
Config 1
Config 2
TMP
Legend 1
Legend 2
Android
Legend
CPL = 1s/1s complement
ALLO = Global alarm too low
ALHI = Global alarm too high
AL1 .. AL32 = Alarm temp too low or too high
OCO1 .. OCO4 = Open collector output
12VL .. 12VR = +12 Volt outputs
OWR1 .. OWR16 = 1-Wire output DS2408
OWR1 .. OWR16 = 1-Wire input DS2408 (if set as input)
IN1 .. IN21 = Inputs when set as Alarm or Analog
ALA1 .. ALA6 = Alarm zone ARMED state
ANA1 .. ANA4 = Analog zone ARMED state
ALM1 .. ALM6 = Alarm from the Alarm Zone
ANM1 .. ANM4 = Analog Alarm from Analog Zone
TI1 .. TI20 = Timer inputs
T1 .. T20 = Timer outputs
TMP1 .. TMP16 = Simple thermostats
TDH1 .. TDH15 = Differential thermostats HEAT (1, 3, 5, 7...)
TDC2 .. TDC16 = Differential thermostats COOL (2, 4, 6, 8...)
CTC1 .. CTC4 = Clear Timer on Compare match event
M1 .. M32 = Shared memory variables
VBAT = Battery discharged (< ~10.8V, > ~12.8V, 2Vhys.)
WDG = No response from NTP after 3 attempts
AC = Astro Corrected
AT = Astro Timer
R = Red
G = Green
B = Blue
ACU = Astro Corrected event up AC↗
ATU = Astro Timer event up AT↗
RU = Red event up R↗
GU = Green event up G↗
BU = Blue event up B↗
ACD = Astro Corrected event down AC↘
ATD = Astro Timer event down AT↘
RD = Red event down R↘
GD = Green event down G↘
BD = Blue event down B↘
& = AND
| = OR
^ = XOR
~ = NOT
! = NOT
DEFAULTS and do not save
READ from the device
SAVE to the device

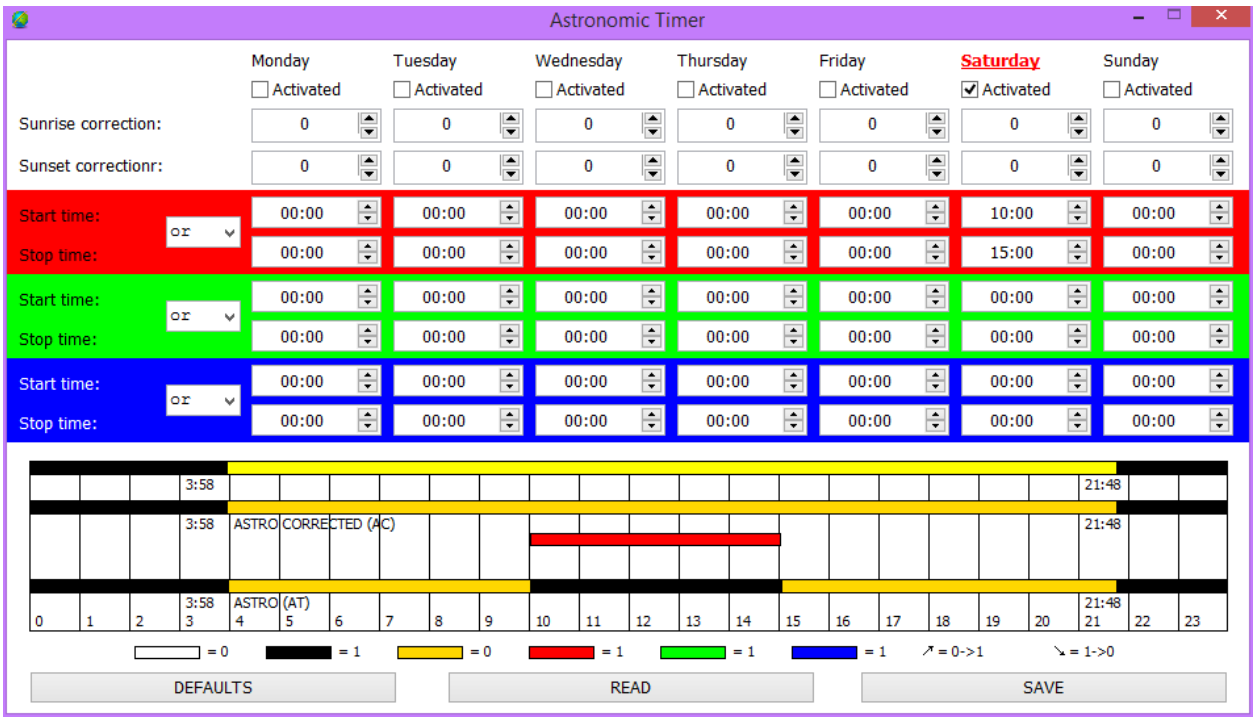
AC – Astro Timer after correction
AT – Astro Timer
R – red part of the timer's diagram
G – green part of the timer's diagram
B – blue part of the timer's diagram



Variables used to detect the beginning or end of the chosen time axis of the Astro Timer.

ACU
ACD
ATU
ATD
RU
RD
GU
BU
BD

The example below shows the red axis of the Astro Timer but it can be analogically applied to other variables of this type.



RU (Red UP) will be activated for 1 second when the set red time period begins.

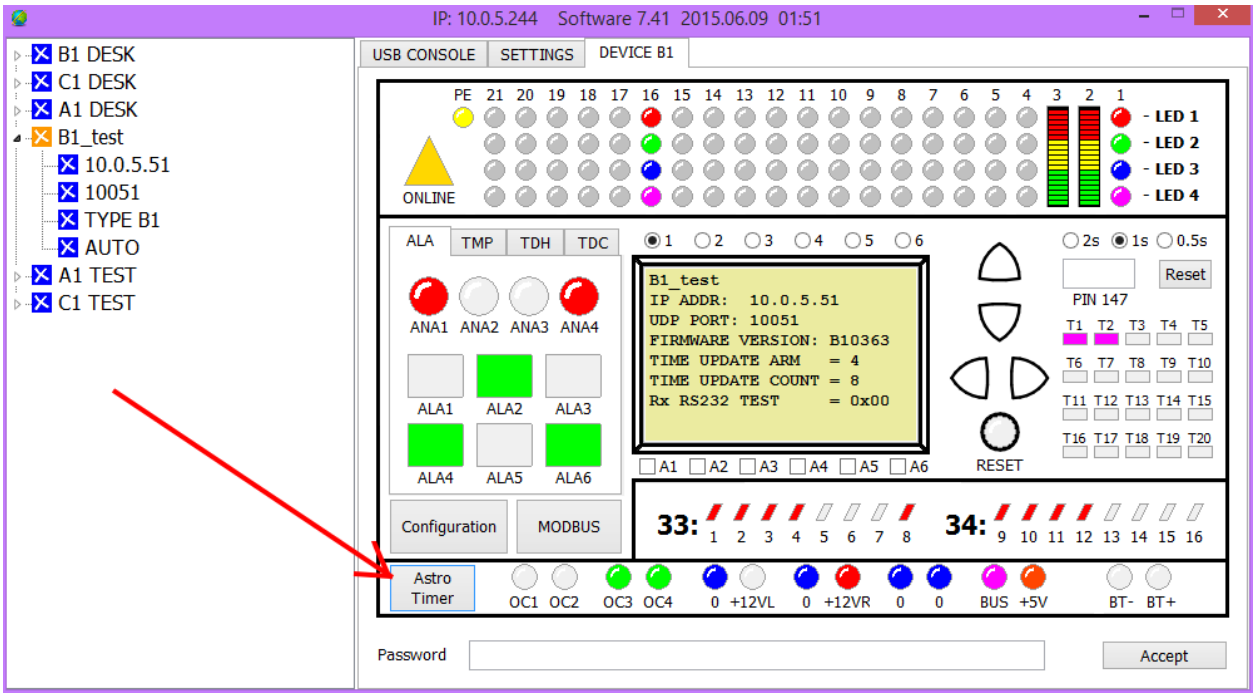
RD (Red DOWN) will be activated for 1 second when the set red time period ends.

RU and RD will both activate just for 1 second after which they will switch off.

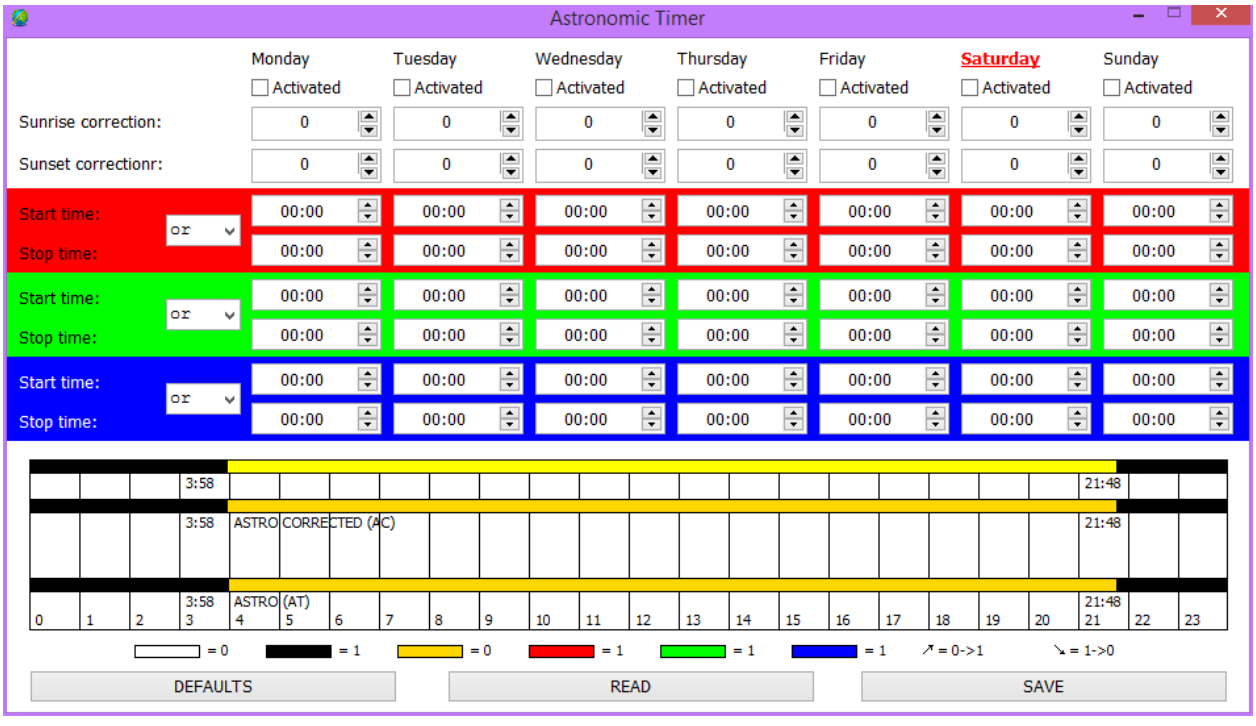
If you want to arm alarm zone 1 ALA1 at the beginning of the red time period:
ALA1 = (RU|ALA1)
If you want to disarm alarm zone 1 ALA1 at the end of the red time period:
ALA1 = (RU&ALA1)
If you want to arm alarm zone 1 ALA1 at the beginning and disarm it at the end of the red time period:
ALA1 = ((RU|ALA1)^(RU&ALA1))

While the command above is correct there is no point of building such a complex equation when you can use a simpler one:
ALA1 = R

To understand what individual phrases mean you need to enter the Astro timer configuration window. On the picture below it is shown with a red arrow.



The Astro Timer configuration window will pop out.

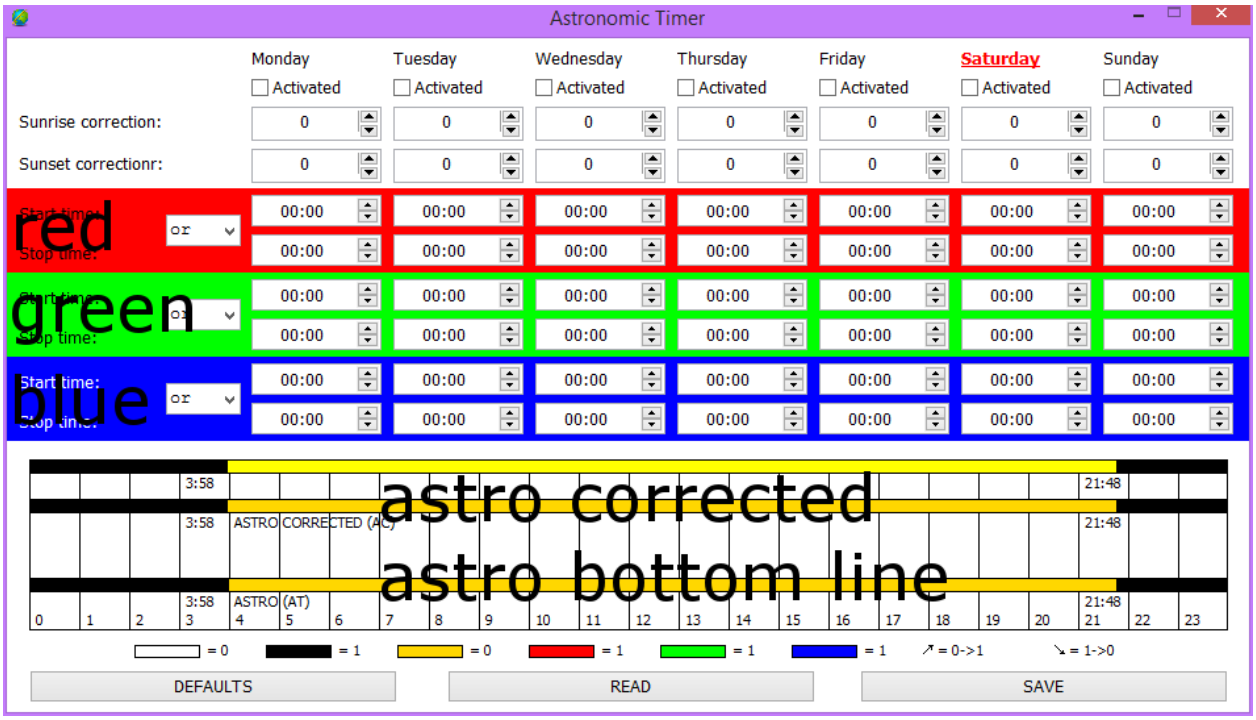


(TIMER RED) = ASTRO TIMER RED TIME LINE

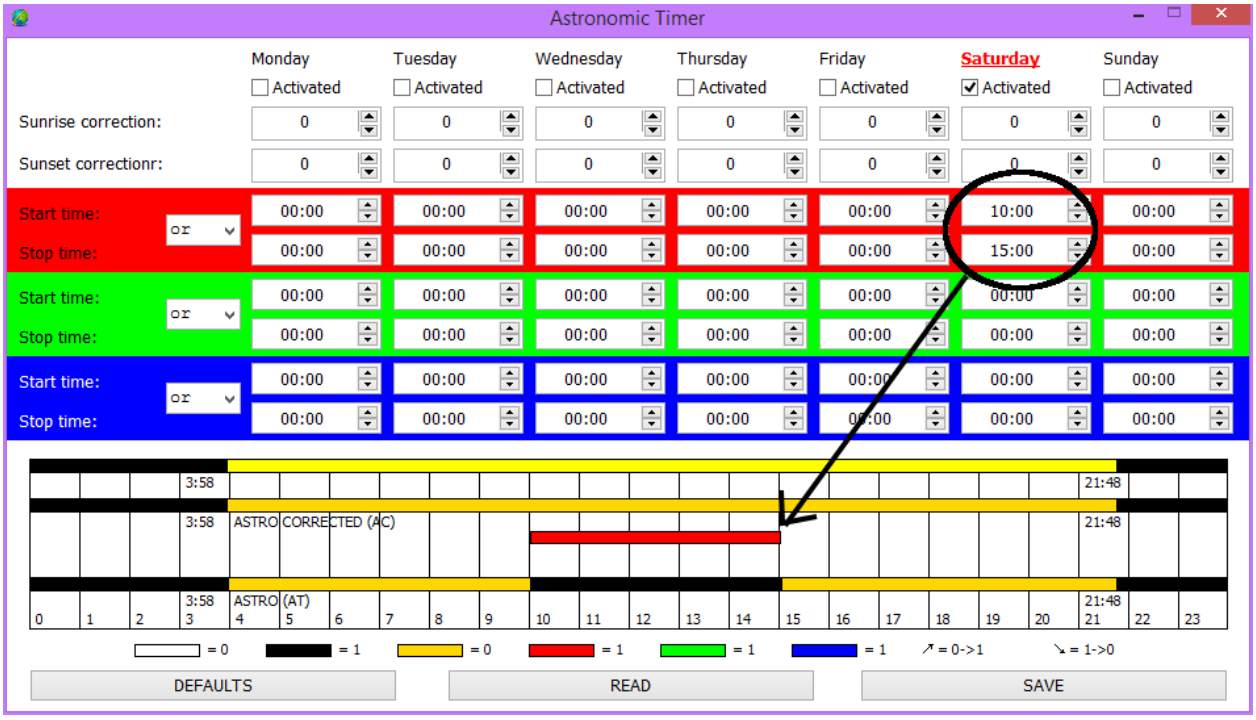
(TIMER GREEN) = ASTRO TIMER GREEN TIME LINE

(TIMER BLUE) = ASTRO TIMER BLUE TIME LINE

The settings of these timers are shown in their colors in the configuration window.



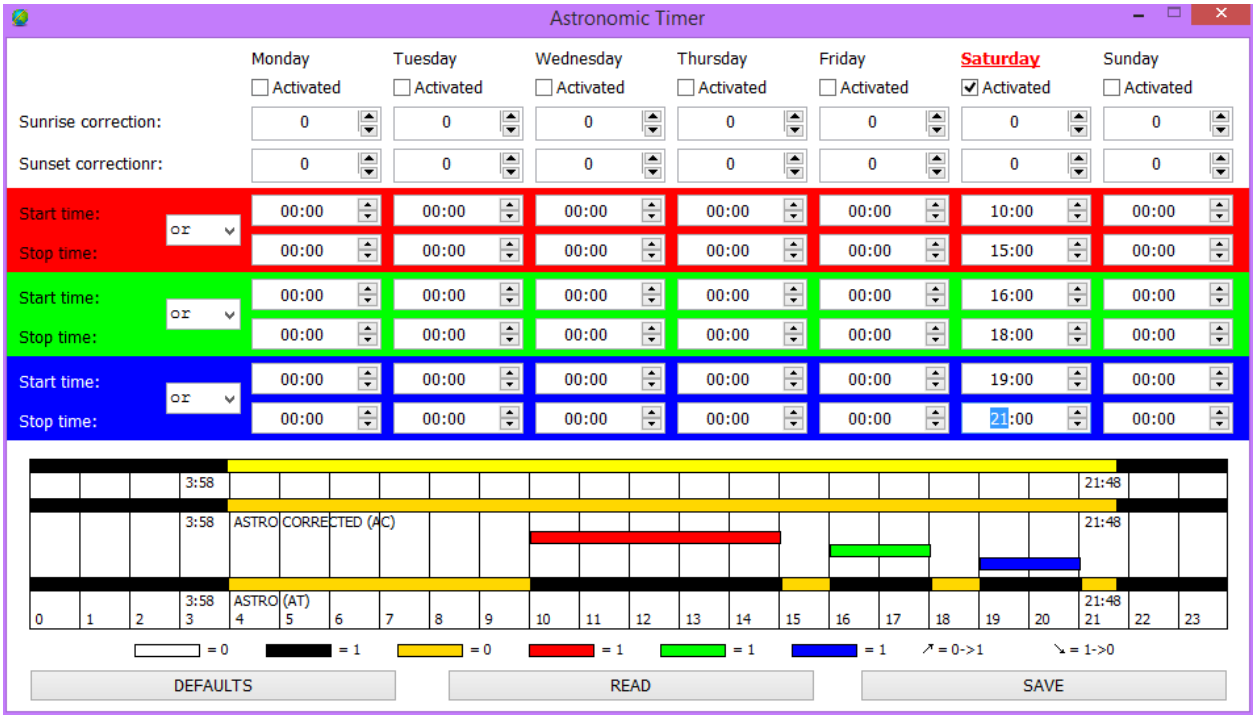
After setting the chosen timer it will be visible on the third bar from the top.



The bars at the bottom always show the diagram for the currently chosen – underlined – day of the week – in this case Saturday.

On Saturday the RED timer was set to:
start at 10 A.M. (10:00)
end at 3 P.M. (15:00)

This period of time is now represented by the red segment on the third bar from the top.
The same is true for the BLUE and GREEN timer.



If you don’t set the timer, the third diagram will remain blank.

In the Start time/Stop time field you can choose the relation between the timer and the corrected Astro Timer.

The OR function will always change the logic status from ‘0’ to ‘1’ but never the other way.

The XOR function will change the sign to the opposite as the Timer ranges always give out value ‘1’.

The OFF function will cause the Timer setting to not be taken into account on the corrected Astro Timer diagram.

This issue was previously described in the Astro Timer section.

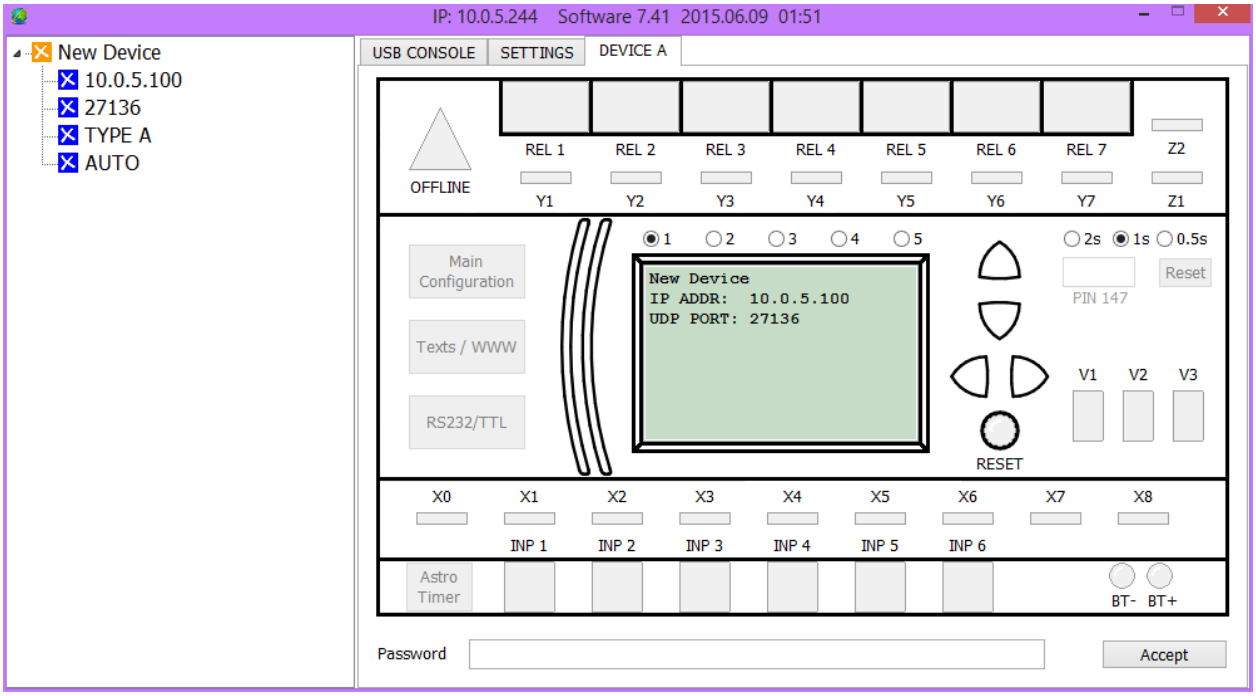
23. SOFTWARE OPERATION – IN SHORT

The basic version of the software used to operate the PLC2011B1 Alarm using a PC is delivered together with the device.

The software does not require installation.
Simply **copy the software file to any location on your computer** and run it.

23.1. Starting the software

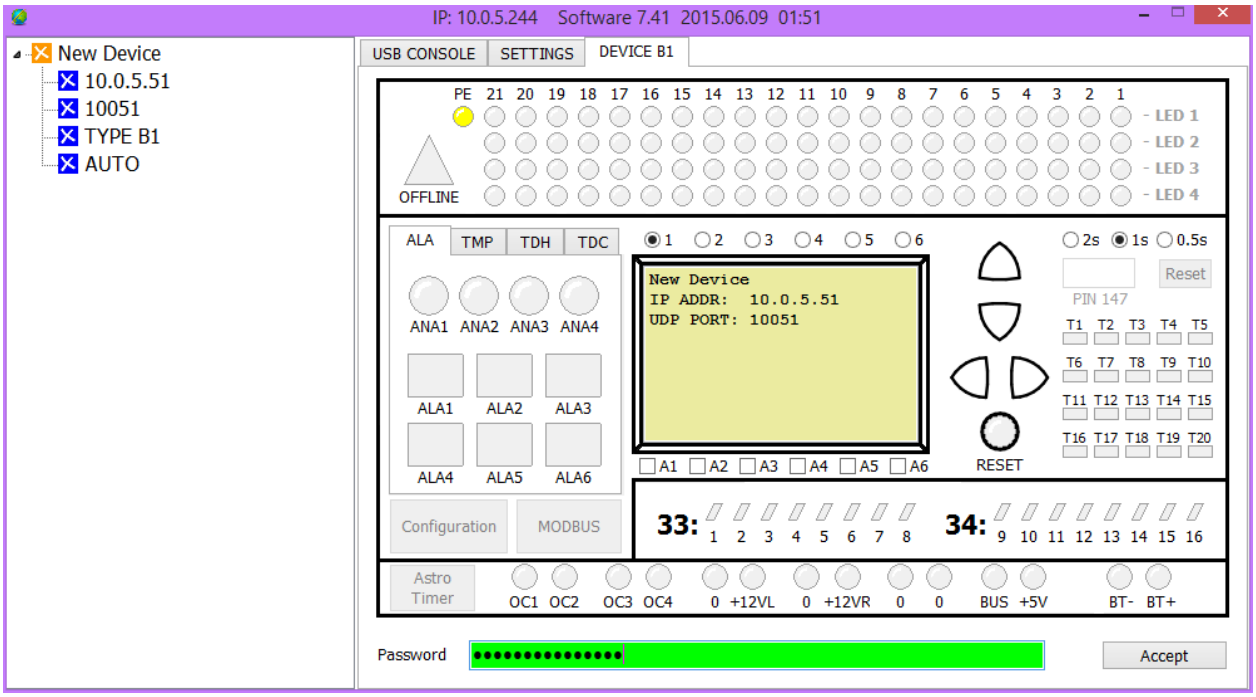
This window will pop out:



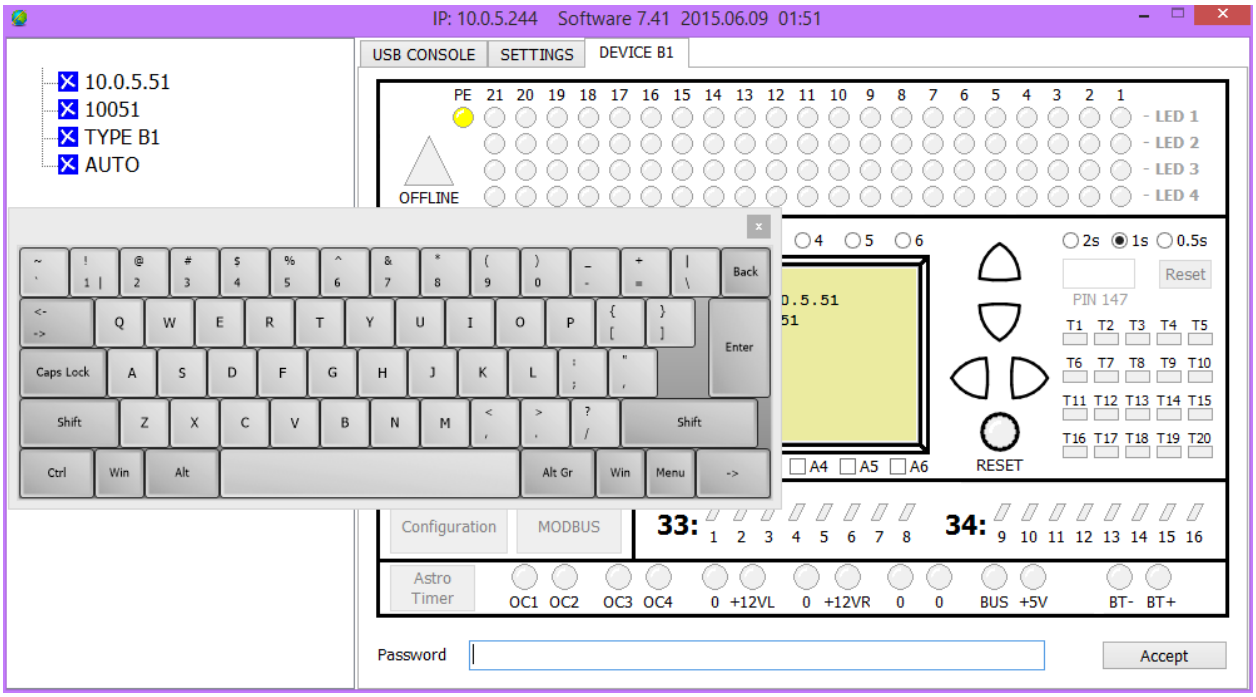
Next you should:

- connect the power supply to the device and then the device to your computer using an USB cable
- do the 'First Run' operation. It is described thoroughly in the beginning of the manual
- when you achieve connection with the Alarm, it's ready to use

23.2. Main window



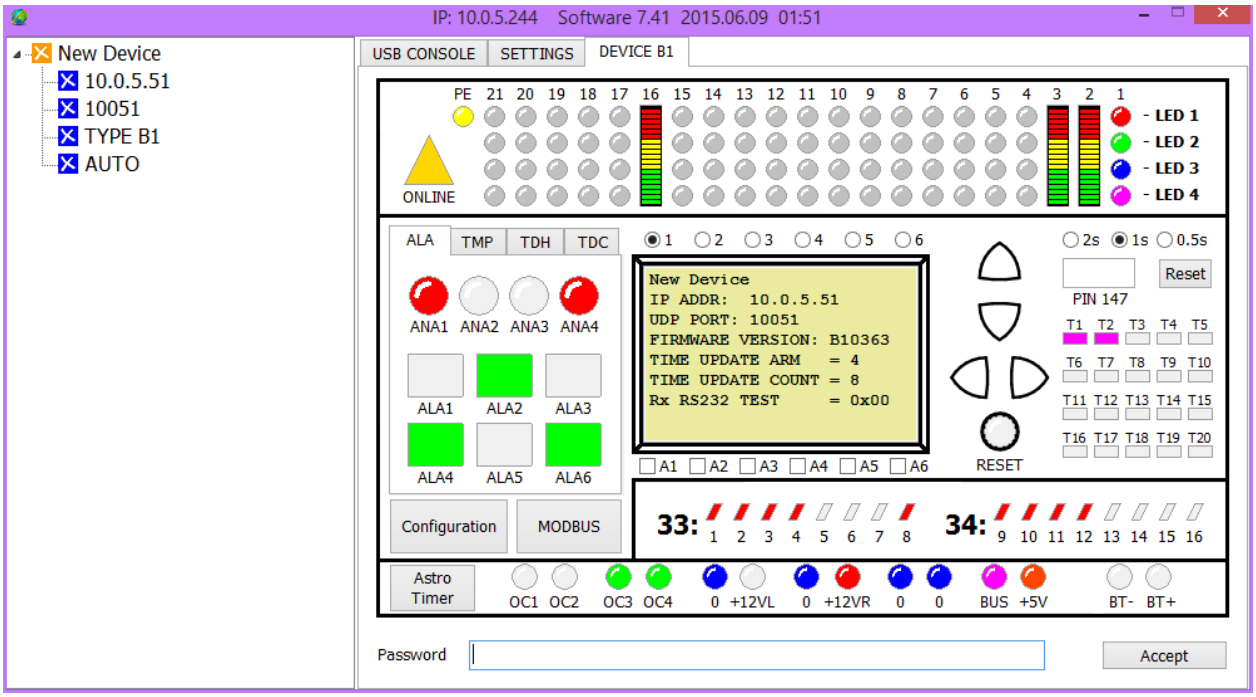
This is how the software looks any time you run it.
At the bottom, in the **Password** field you need to enter the 15-letter or longer password that you have set during the **First Run** procedure and the press **Accept**.



When you double-click the field where you enter the password, a virtual keyboard which you can use to enter the password will pop-out.

You need to enter the password every time you run the software.
Without entering the password it is impossible to connect to the device through the internet.

After you enter the correct password for the chosen relay, the triangle indicator will turn yellow.
This means that connection has been achieved.

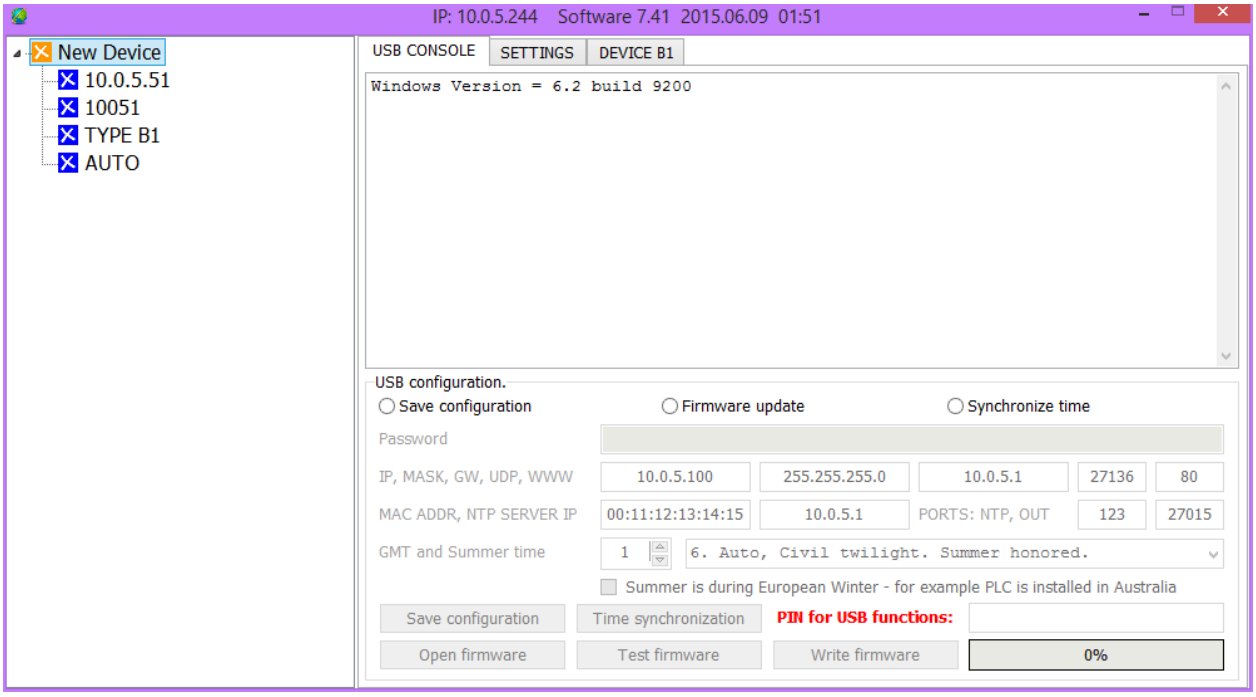


23.3. USB Console tab

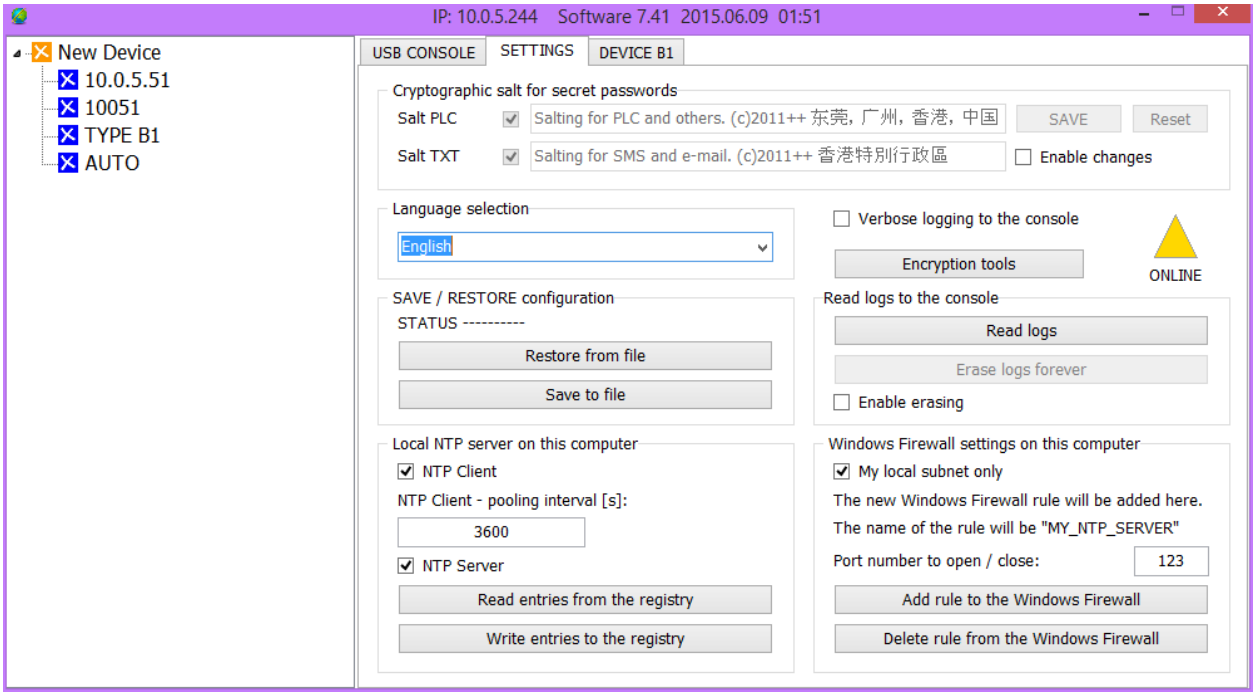
This tab is for:

- configuring the device and setting up the password
- updating firmware
- synchronizing time

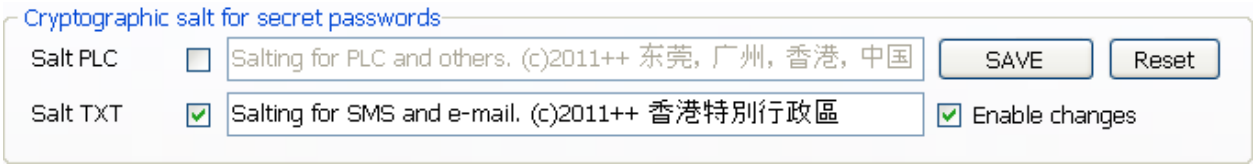
All these procedures require the device to be connected to the computer with an USB cable.



23.4. SETTINGS tab

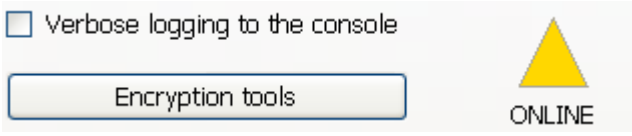


CRYPTOGRAPHIC SALT FOR SECRET PASSWORDS

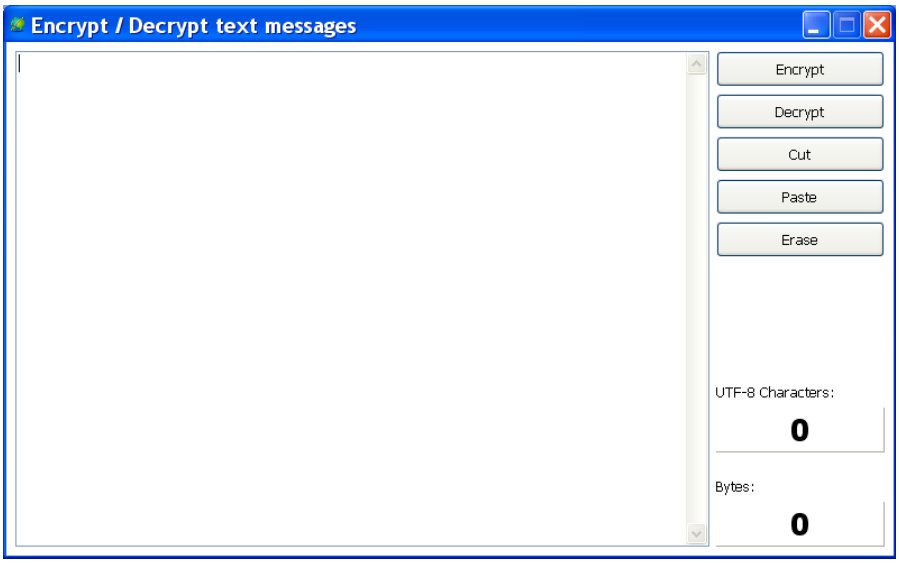


Salt configurations are described in the Password and Salt section.

ECRYPTION TOOLS



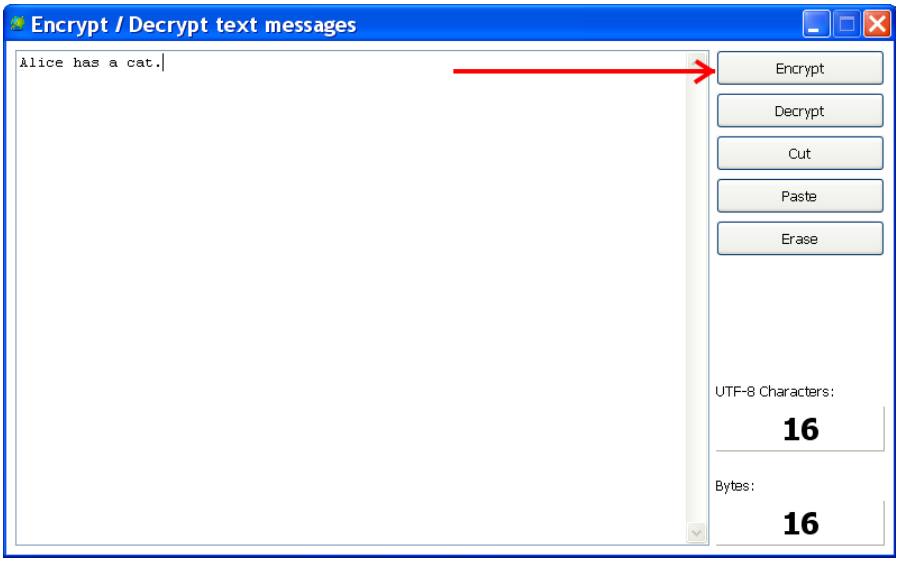
After pressing the **Encryption tools** button a new window will pop out.



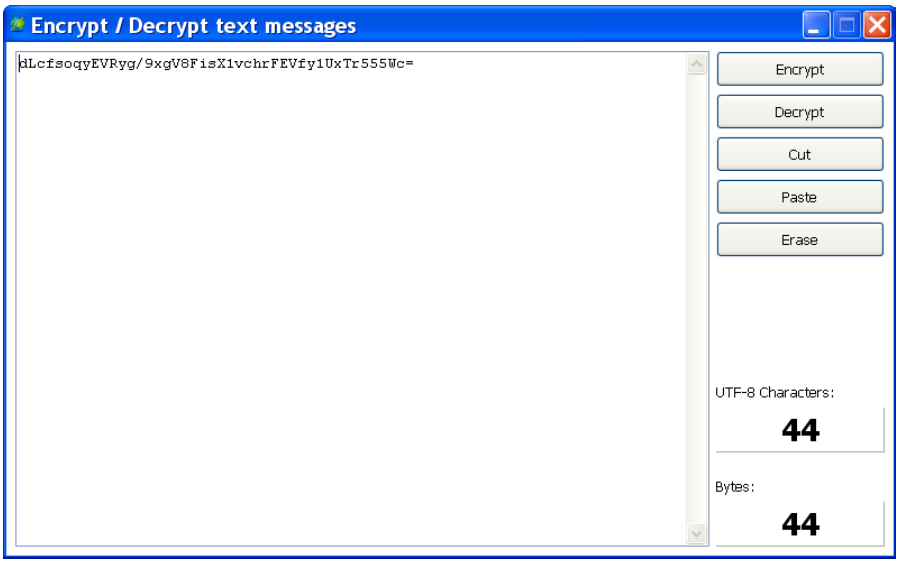
This window can be used to enter/paste and encrypt text.

To do this, you first need to enter a password in the field where you normally enter the password to your device. This password will then be used to decrypt the text. The entered password does not have to be the password to one of your devices.

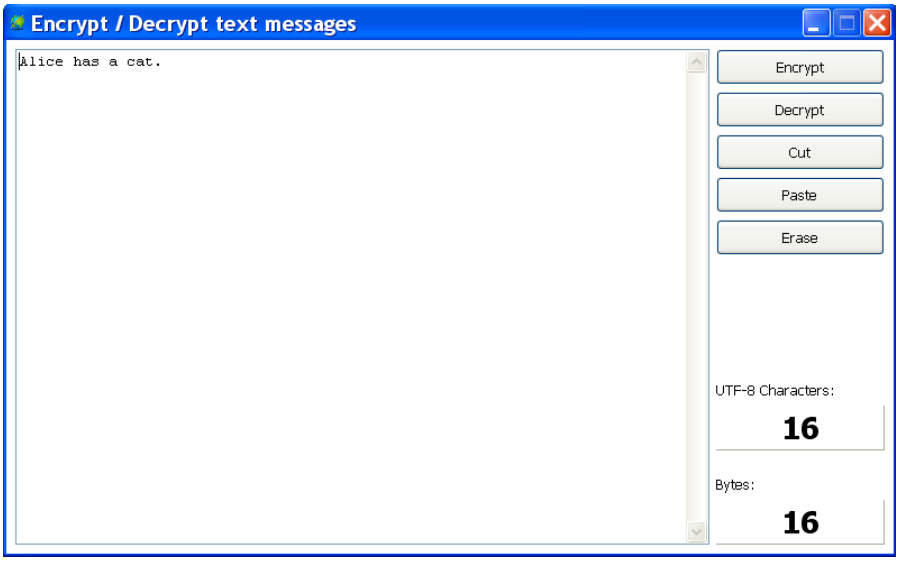
For example, let's say that the password is the first 15 letters of the alphabet. Enter and accept them and re-enter the **Encryption tools** window. In the main text field enter a short text, e.g. 'Alice has a cat' and then press the **Encrypt** button.



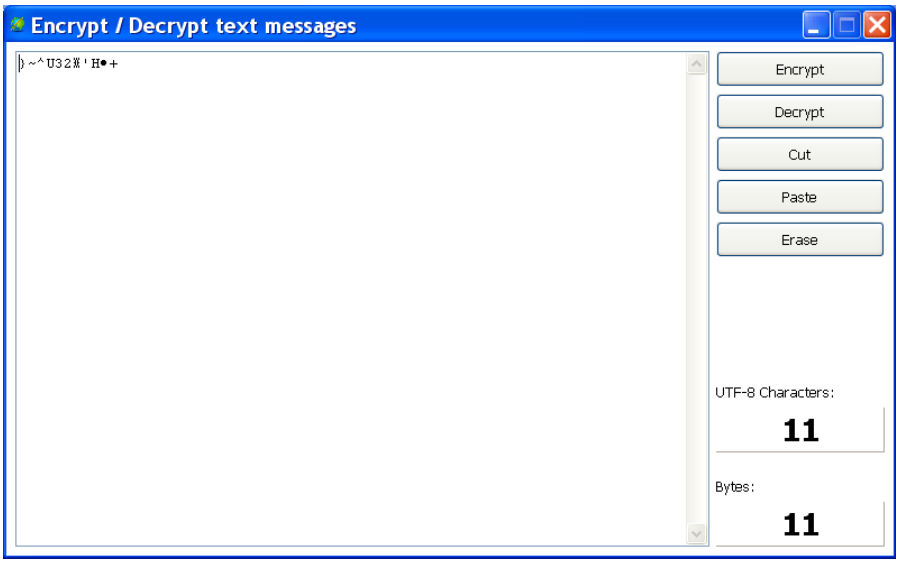
The text will be substituted with a character string.



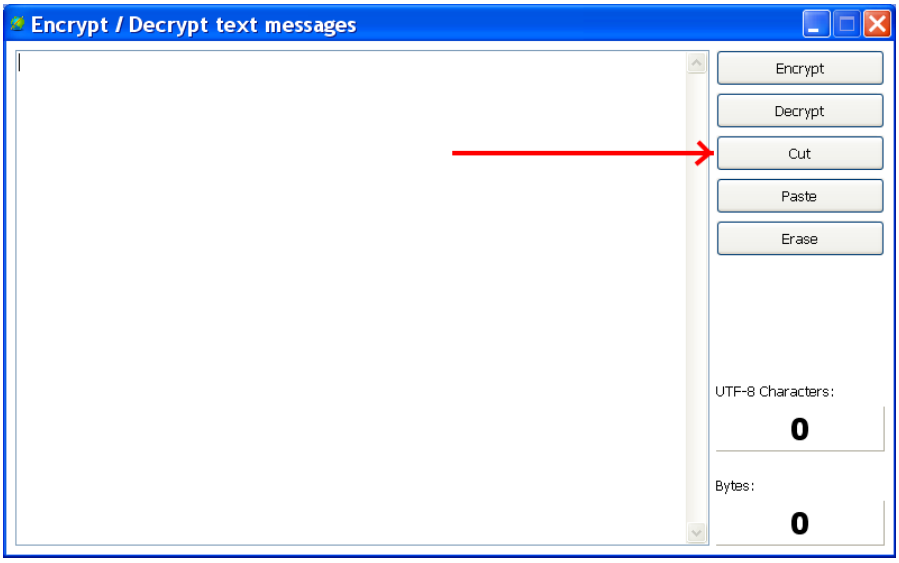
Now, if you press the **Decrypt** button, the character string will change back into the previous text. The character string will be different each time even if the password stays the same.



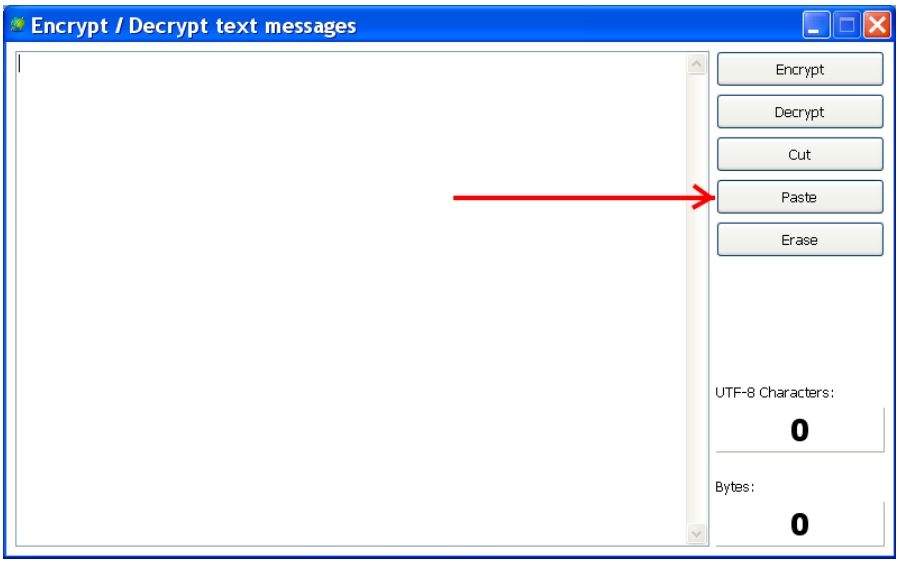
If the password is changed between encryption and decryption, the decryption will not be successful. Instead of the original text, you will get back a different character string.



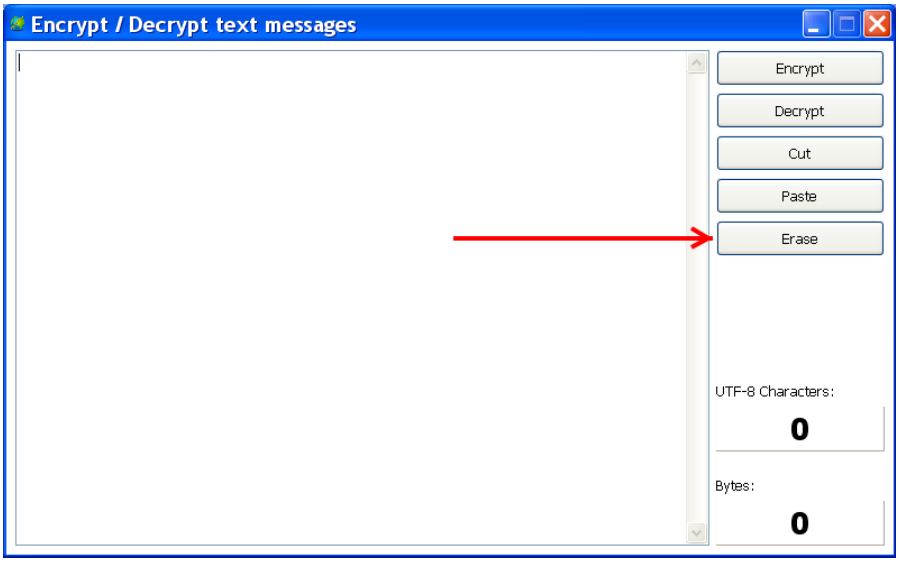
Only after you enter the password that was in use during the encryption, will you get the original text. In this example, the text will be decrypted after you re-enter the first 15 letter of the alphabet.



The **Cut** button clears the contents of the screen and copies it to storage. You can then paste it anywhere else, like an SMS, a text document or an e-mail using the paste function.



The **Paste** button enters the content of the storage to the software encryption window.



The **Erase** button permanently erases the contents of the window, together with the text, and clears the place in the computers memory where the password was stored.

Using the **ENCRYPTION TOOLS** function you can send someone a secret, encrypted message.

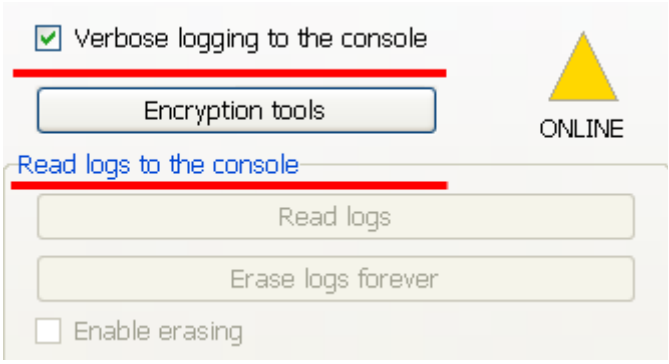
The recipient will only need the relay software, even if he himself does not own a device, and the password to read the message.
If someone unauthorized intercepts the message then without the software and the password, the message will be useless to him. The message can be read only by a person who knows the password.
Also remember that the SALT TXT function influences the ability to read someones encrypted message. This function is for groups of people in e.g. one home or office who want to keep their correspondence confidential from telecommunication companies and use the same password and salt.

For safety reasons, every message should have a different password and you should not use passwords which you use elsewhere, e.g. in your e-mail account. The password must have at least 15 characters. When entering the password remember that the software differentiates capital and small letters. The letter 'A' will be treated different than the letter 'a' and the software will act in the same way with other characters. Before entering the password remember to check whether the **Caps Lock** button is pressed as this can be a frequent reason as to why the password could be read as wrong.

You should also check SALT TXT settings (analogically as when setting SALT for PLC)

Salt is a non-confidential text and you do not need to hide it. It is an additional obstacle in the process of trying to break the password using mathematical methods.

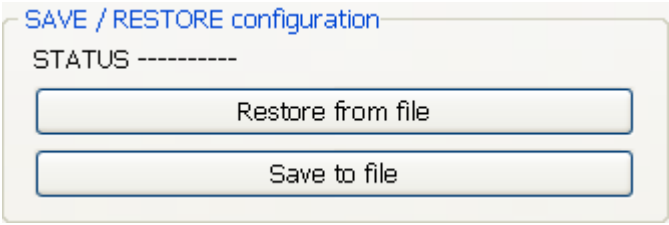
VERBOSE LOGGING TO THE CONSOLE
READ LOGS TO THE CONSOLE



The device remembers up to 59 last alarms including the date, hour and number of the input where the alarm occurred.

To read the logs you need to press the **READ LOGS** button in the **Read logs to the console** field and then switch to the **USB Console** tab where up to 59 last alarms will now be displayed.

SAVE/RESTORE configuration



The current configuration of:

- inputs
- outputs
- astro timer
- www server

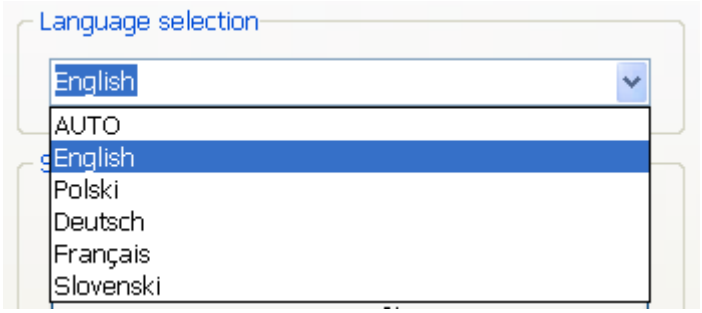
can be saved to a file (*.ccr) by pressing the **Save to file** button.
At the moment of saving the message 100% OK will be displayed for a moment instead of the word STATUS.

To restore the settings or apply the in another device, after picking it from the list in the left part of the window and connecting to it, you need to press the **Restore from file** button, find the configuration file and press **Open**.

The device will load the configuration file and restart.
In the STATUS field the information "RESET" will be shown.

This does not concern the main configuration as the network settings etc.

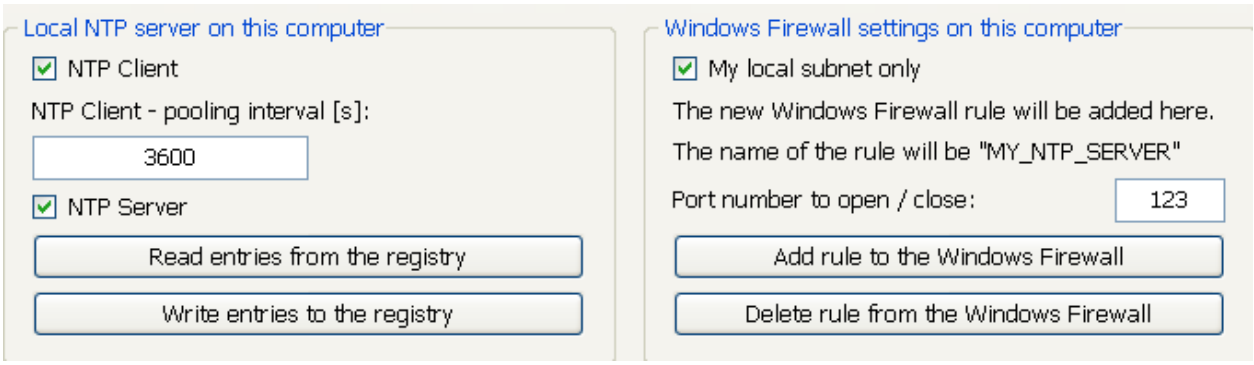
LANGUAGE selection



You can choose the language from a list.
After setting AUTO the language automatically switches to the language of your Windows.

Language settings are saved automatically after every change.

!!!To use the following settings you need to log on as the administrator on computers with Windows7!!!


Local NTP server on this computer
NTP Client
NTP Client - pooling interval [s]:
3600
NTP Server
Read entries from the registry
Write entries to the registry
Windows Firewall settings on this computer
My local subnet only
The new Windows Firewall rule will be added here.
The name of the rule will be "MY_NTP_SERVER"
Port number to open / close:
123
Add rule to the Windows Firewall
Delete rule from the Windows Firewall

Local NTP server on this computer

This is a tool that allows you to configure your computer to be the NTP server. This menu does not require being connected to the device as it's used to configure only your computer.

NTP client – this service downloads the current time from the internet. It should always be on.

NTP server – this service will allow other computers or relays to download the time from your computer. It will 'serve' time to relays.

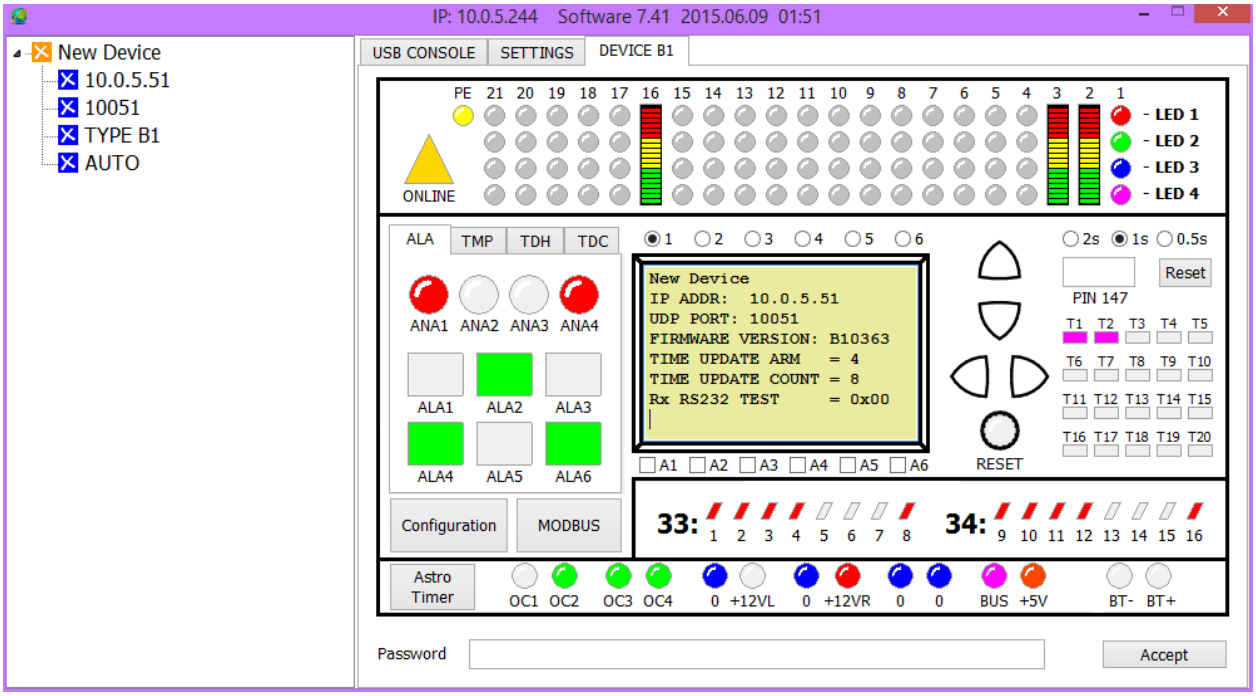
NTP Client – pooling interval – how often (in seconds) will your computer download time from the internet as an NTP client. If you want the time in your computer to be correct you should enter 3600 – update every hour.

Windows Firewall settings on this computer

You need to configure your Windows Firewall to let through requests going to the NTP server if you want your computer to work as one. You need to allow UDP packets with port number 123 to go from the LAN to your NTP server service.

In Windows Vista and Windows 7 you need to run the software when logged in as the administrator.

23.5. DEVICE B1 tab

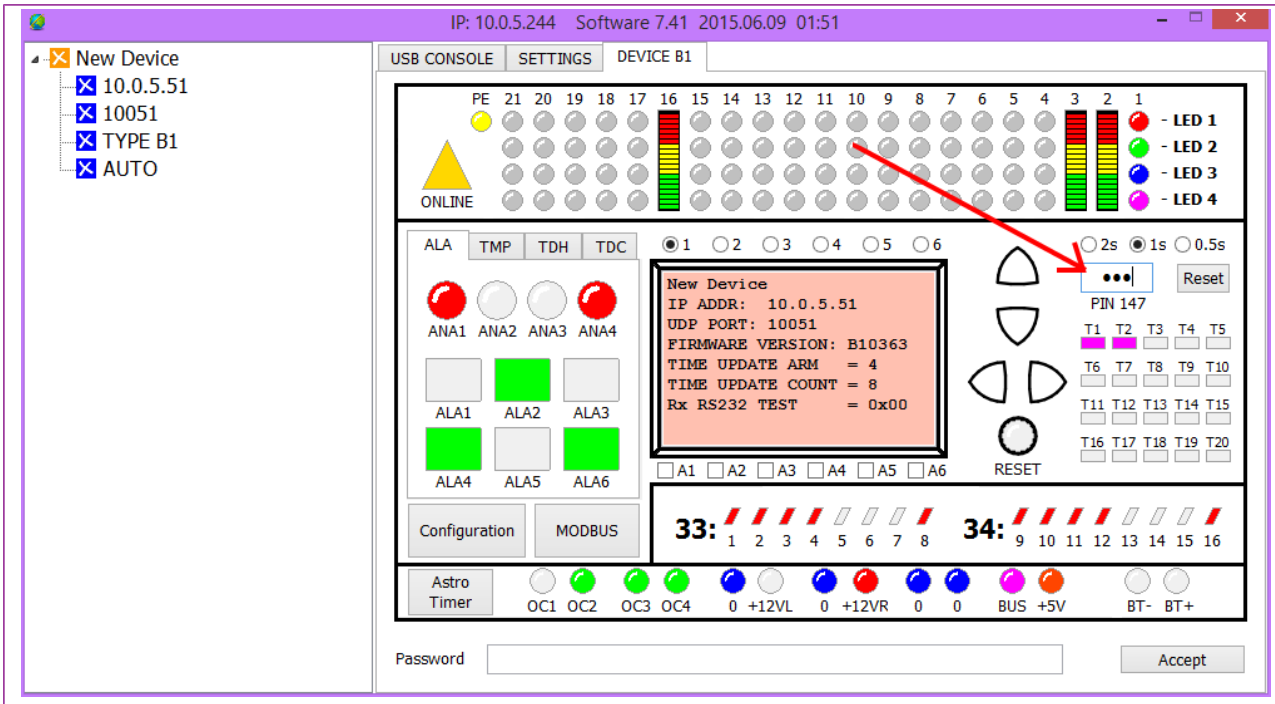


This window is used for controlling the alarm, configuring inputs and outputs, variables, the Astro Timer.

Here you can see the current status of the sensors connected to inputs, alarm zones, and 1-Wire bus for the Alarm that you had chosen from the list and connected to.

Manually arming and disarming the alarm is possible after you enter the **147** PIN code in the field on the right of the window. After you enter the code, the display in the middle of the window will change color to pink.

When you are finished making changes, we advise you to switch back to safe mode so that you do not press and change anything by accident. To do this press the **Reset** button next to the field where you entered the code. The display will go gray again and you will be able to make changes only after you enter the code again.

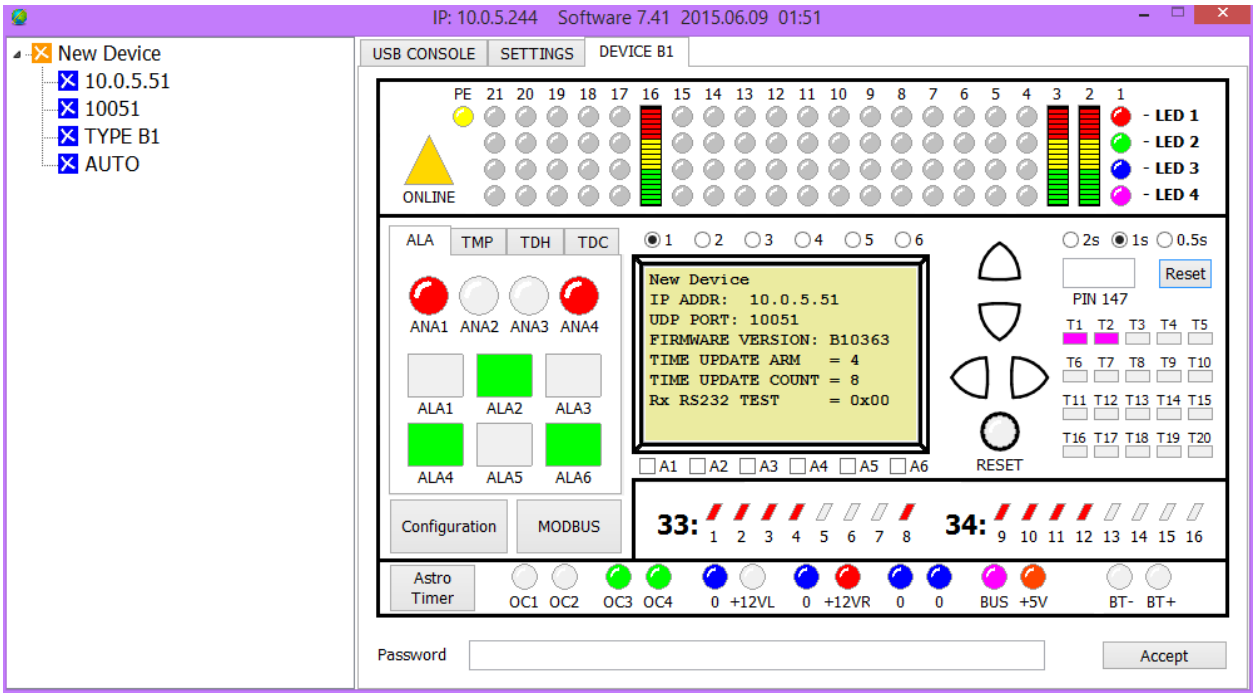


Display

The display in the middle of the main window has 6 screens.
You switch between the screens by selecting one of the five radio buttons above the display.

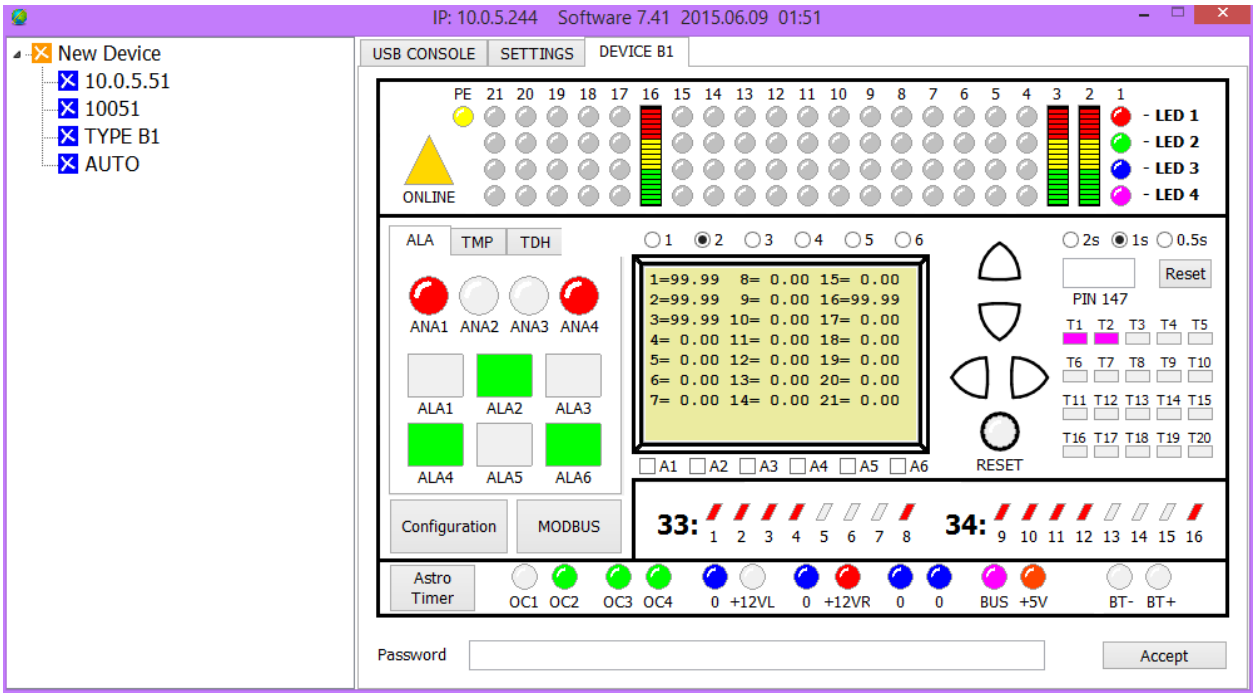
Screen 1

- name of the device chosen from the device list
- the device's IP address
- UDP port number
- firmware version



Screen 2

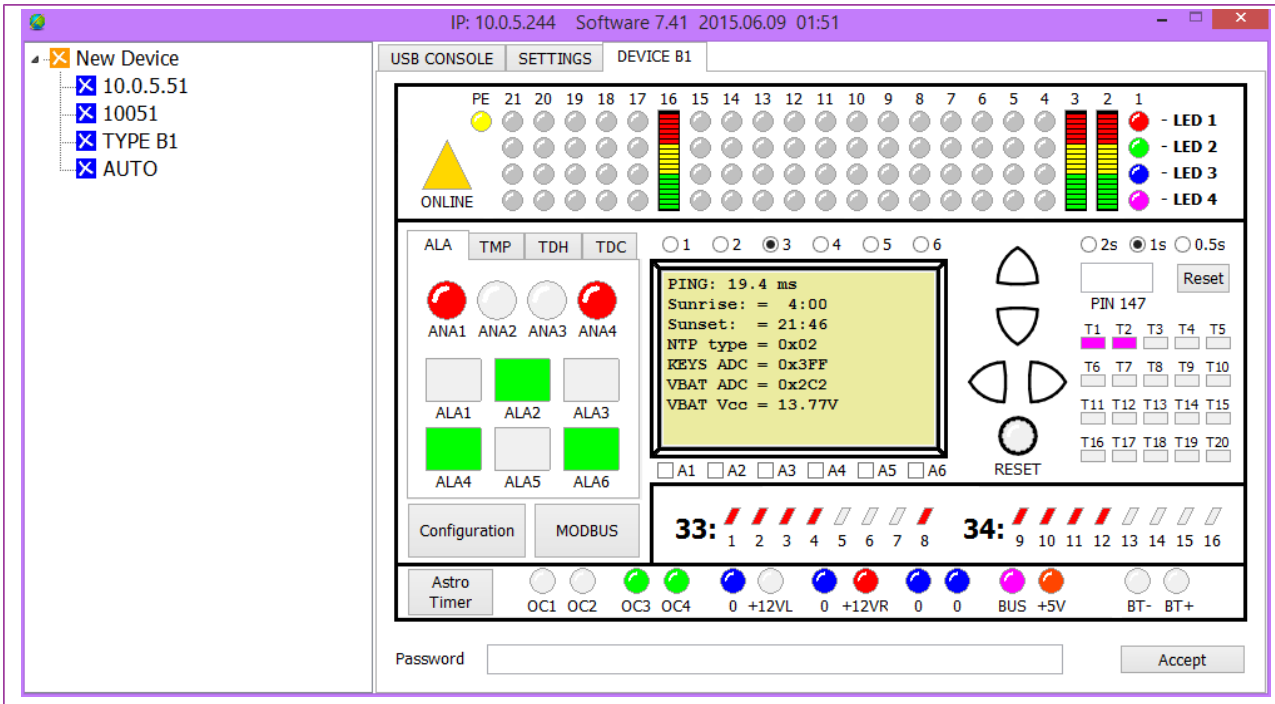
Shown in this screen are current resistance values for all 21 inputs. Only the configured and assigned to an alarm zone inputs are active.
This screen is also used for input calibration with a 7.5k resistor.



Screen 3

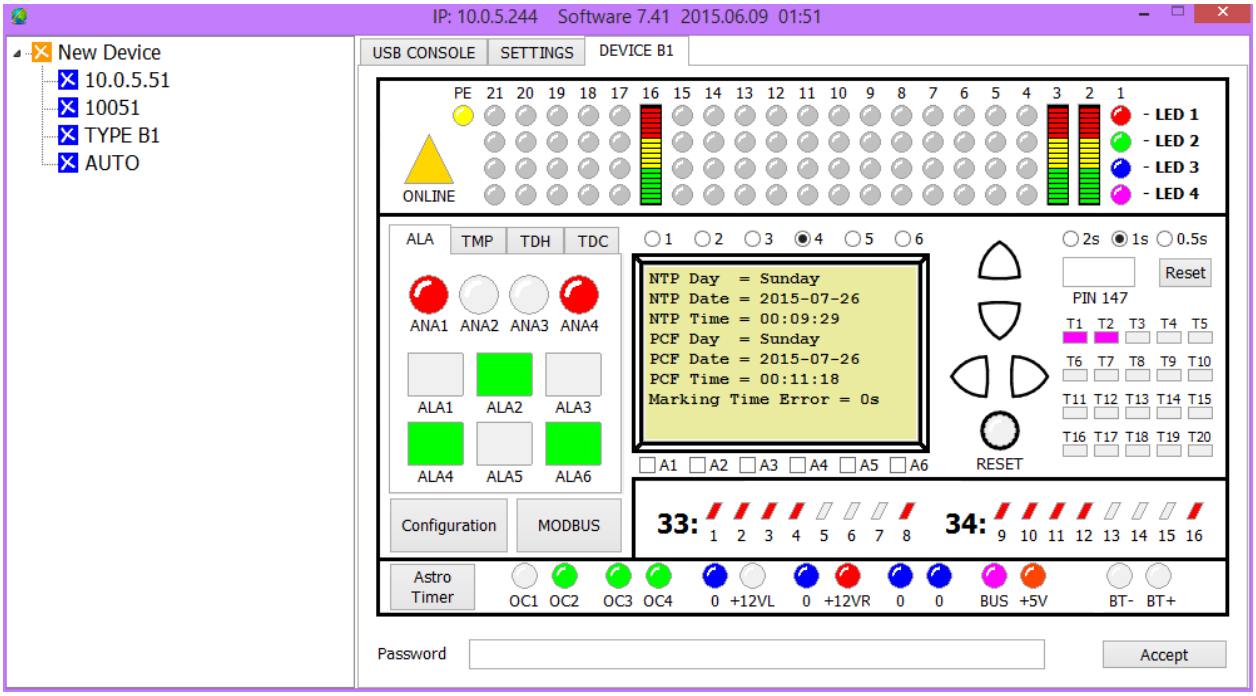
- ping between the device and the computer, from the moment a packet is sent to the moment an answer is received
- sunrise and sunset times
- current battery voltage, you need to calibrate it in the main configuration window
- other parameters are only used for testing and can change

Calibration of the voltage of the battery is done in the following way. Connect the battery and measure the voltage on it's clamps using a multimeter. In the Main Configuration window (the button above the Astro Timer button) enter the correction, either + or -, save the setting and wait for the restart. Next, compare the readings in these screen to those from the multimeter. Continue the calibration until you reach the desired effect.



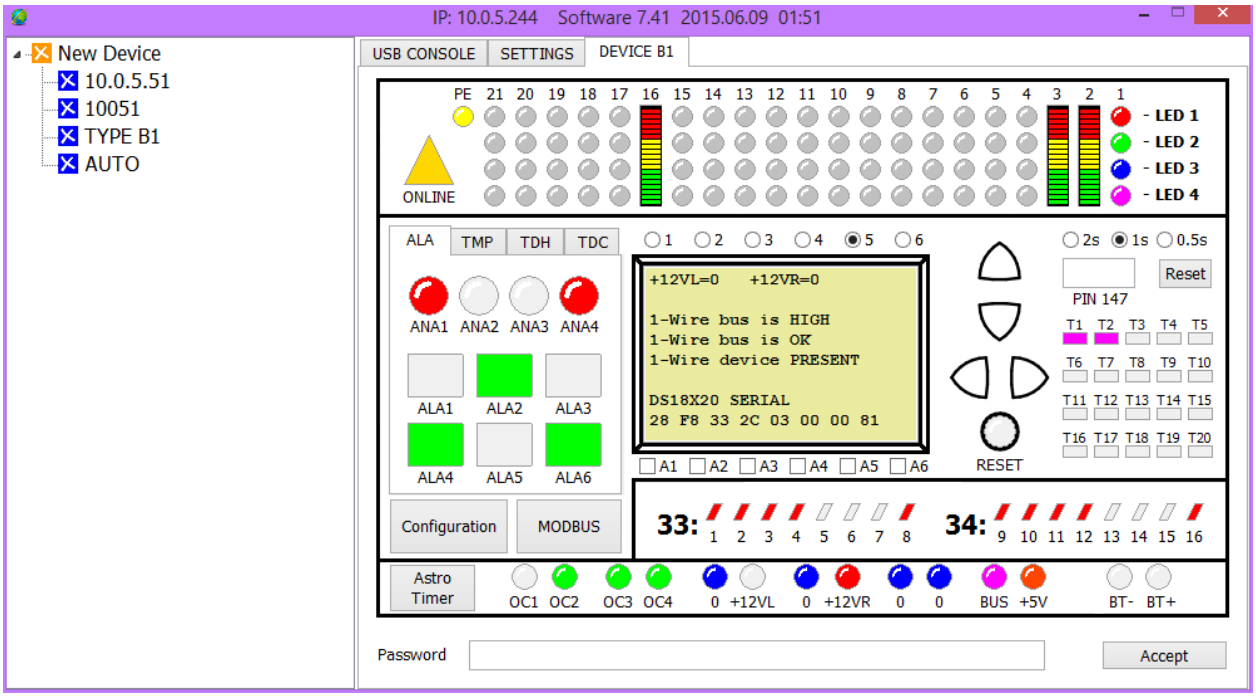
Screen 4

– time according to the NTP server and the device's internal clock and the difference between them. Here you can check if the time synchronization was successful.



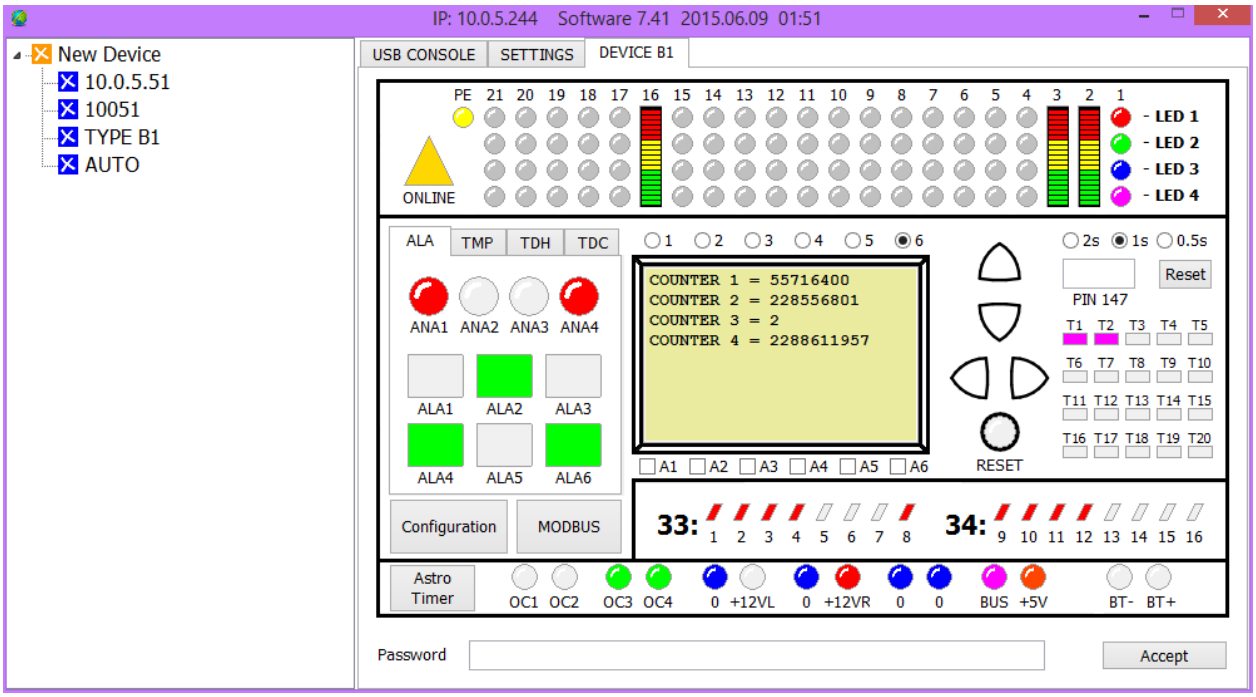
Screen 5

- information about +12V output overload
- information about 1-Wire bus status
- an individual 1-Wire thermometer serial number



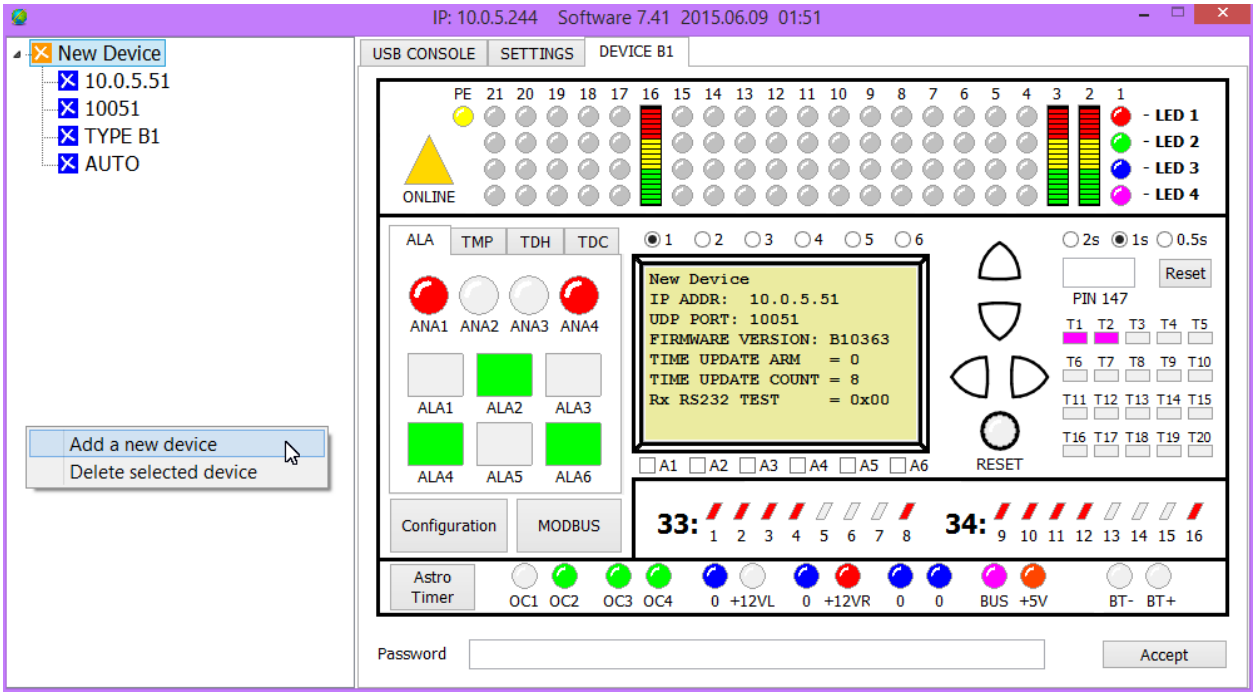
Screen 6

- current counter status in inputs 1 – 4



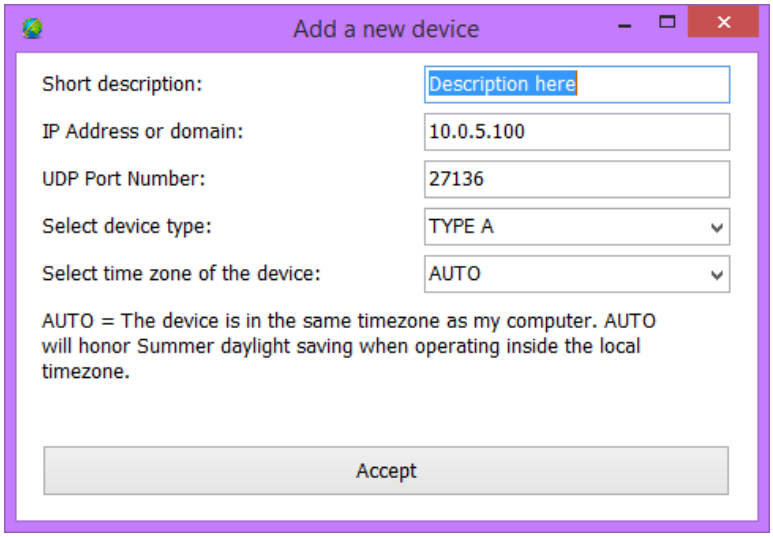
23.6. Adding a new device to the list

To add a new device (alarm or relay) to your list right-click in the field where the list is placed on the left side of the window.



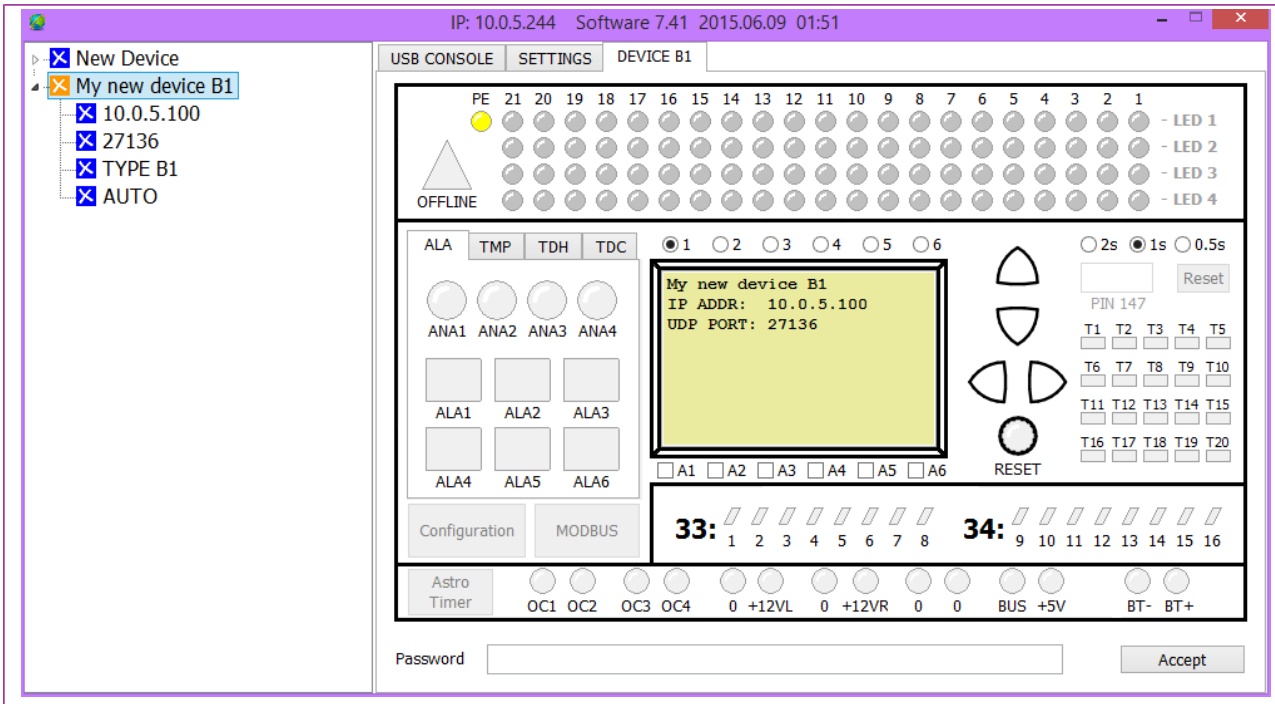
Pick **Add a new device**

The **Add a new device** window will pop out. Here enter the device name you want to be displayed on the list, the device's IP address, UDP port number, device type and the time zone where the device is placed. If the device's timezone is the same as the computer's timezone then pick AUTO.


Add a new device
Short description:
Description here
IP Address or domain:
10.0.5.100
UDP Port Number:
27136
Select device type:
TYPE A
Select time zone of the device:
AUTO
AUTO = The device is in the same timezone as my computer. AUTO will honor Summer daylight saving when operating inside the local timezone.
Accept

TYPE B1 – PLC2011B1 Programmable Alarm

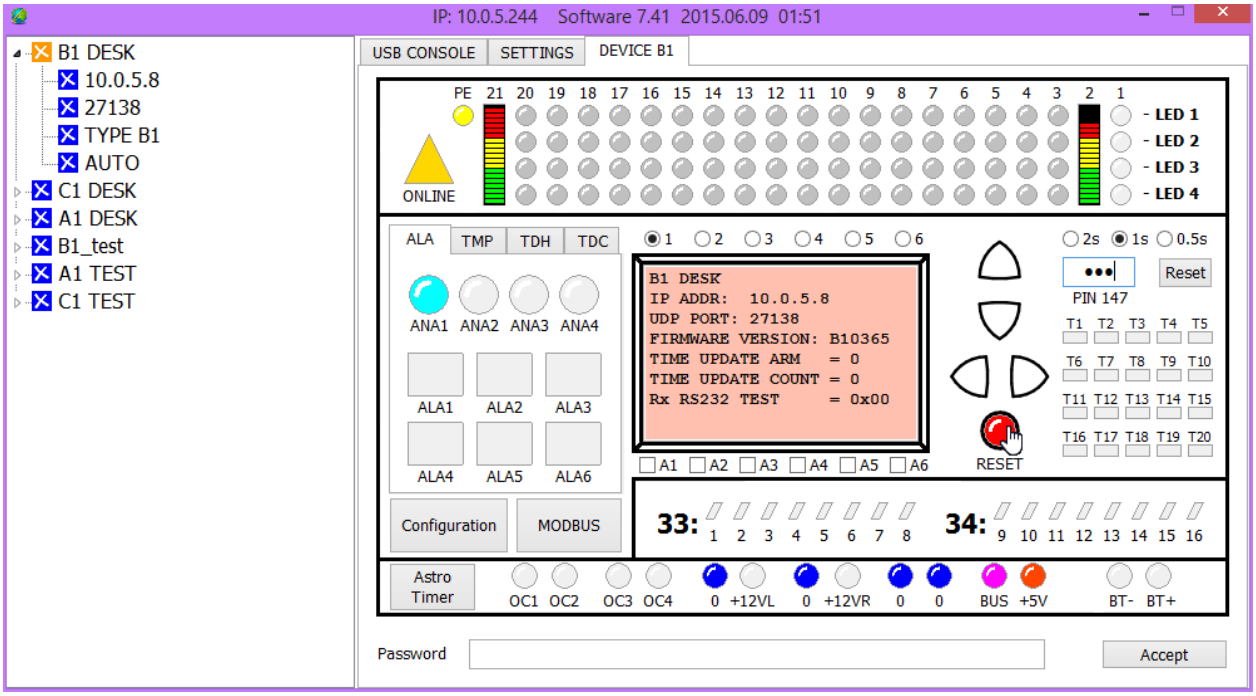
You save by pressing the **Accept** button.



The added device will be displayed on the list on the left of the window.
To connect to it you need to choose it, enter the password and the accept it.

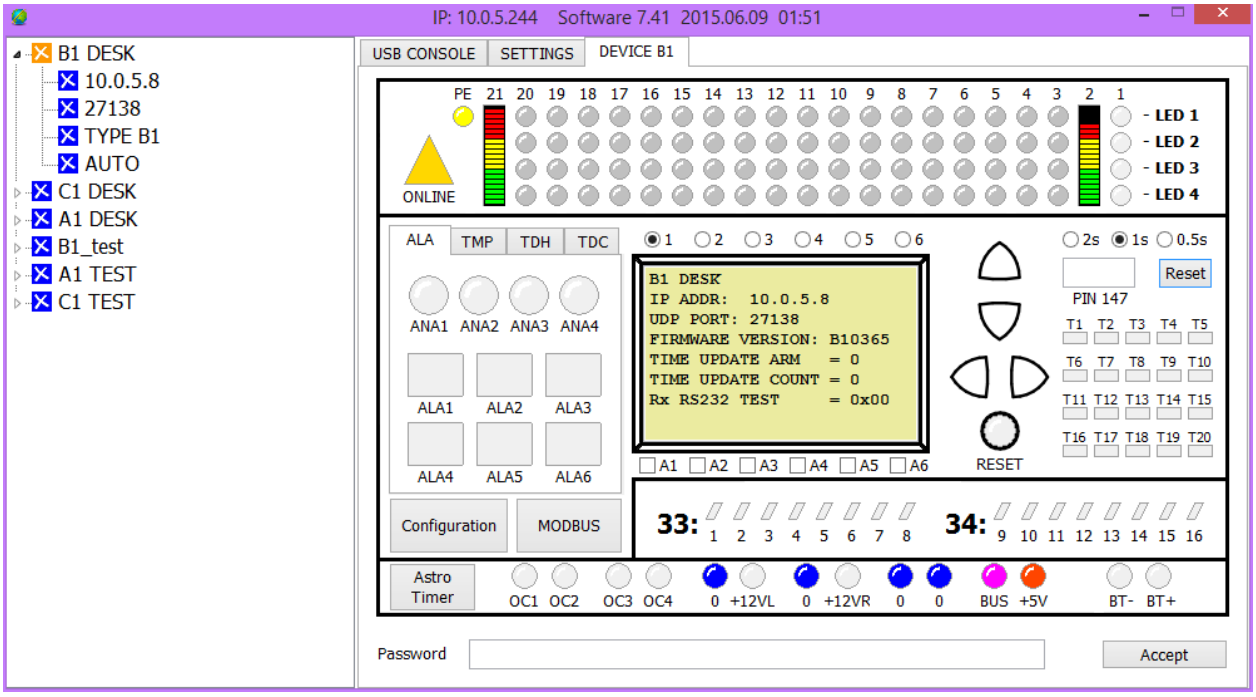
Of course, the device must be configured and assigned a password earlier.
These operations are described in earlier chapters of this manual.

23.7. Resetting the device using the software



To reset the device you need to press the round button next to the display (147 code first). The cursor will change to a hand when you put it over the button. The button changes to red when pressed.
A reset of the device will put all variables into the same status that occurs in the moment you connect the power supply, time counters will be deleted an all not set statuses will be deleted after which the device proceeds to normal operation. This is a reset of the software.

This is how the main window looks after a reset.



23.8. Operation in tray (task bar next to the clock)

Double-clicking the display will cause the program to collapse to an icon on the toolbar next to the clock.

24. FIRMWARE UPDATE

To update the firmware you will need the **PIN code**. The code is placed on a sticker on the cover of the CD with the device's drivers.

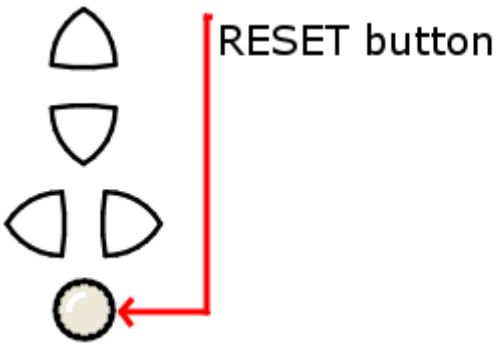
24.1. How to turn on the firmware update mode

1. Turn on the power supply

2. Connect the device to your computer using an USB cable - the USB socket is on the left side of the device's front panel

3. Wait 10 second

4. Press and hold the RESET button on the device's front panel



You need to hold the RESET button for ca. 10 seconds. The LEDs will switch on in the following way:

- all three LEDs switch on
- red LED stays on
- yellow LED switches on (let go of the RESET button)

When the yellow LED turns on, you need to let go of the RESET button.

When the green light switches and stays on, that means the device is now in the **firmware update mode.**

24.2. Firmware update

When the device is in the firmware update mode, you need to:

1. Open the software on your computer

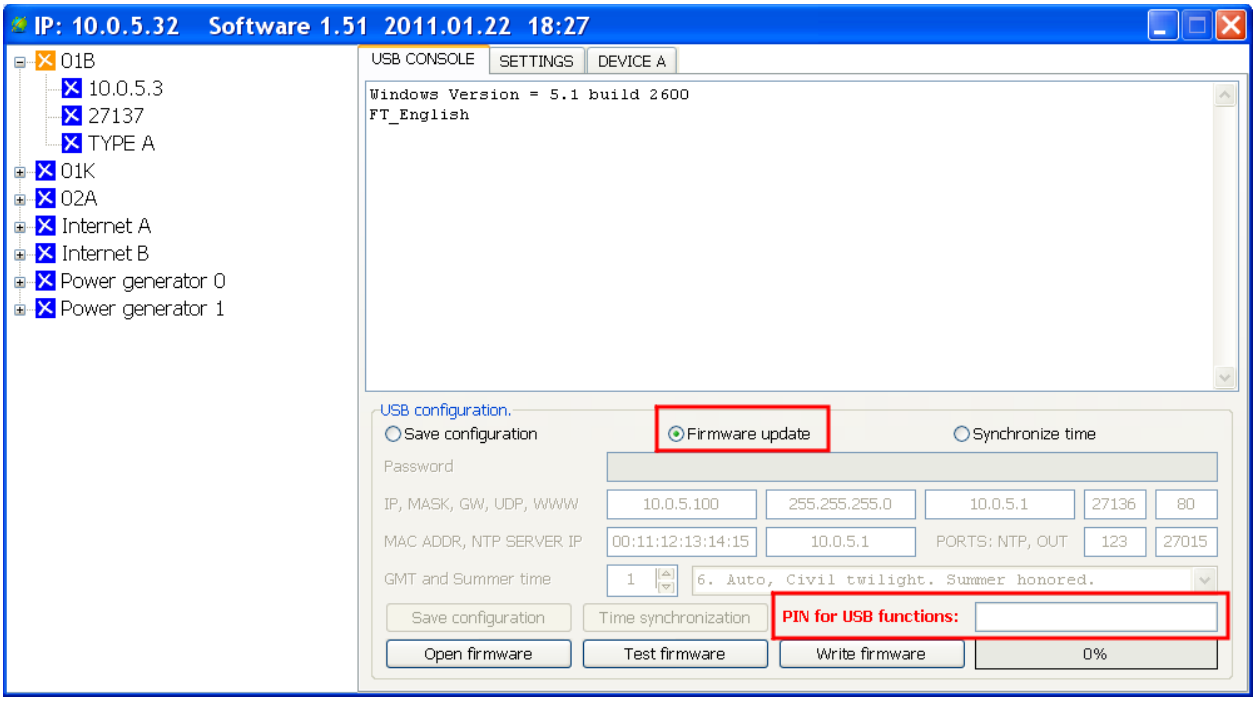
2. Go to the **USB Console** tab

3. In the **USB configuration** field pick the **Firmware update** option button

4. The lower buttons and the box where the PIN code should be entered will become highlighted.

5. Enter the PIN code into the **PIN for USB functions** box

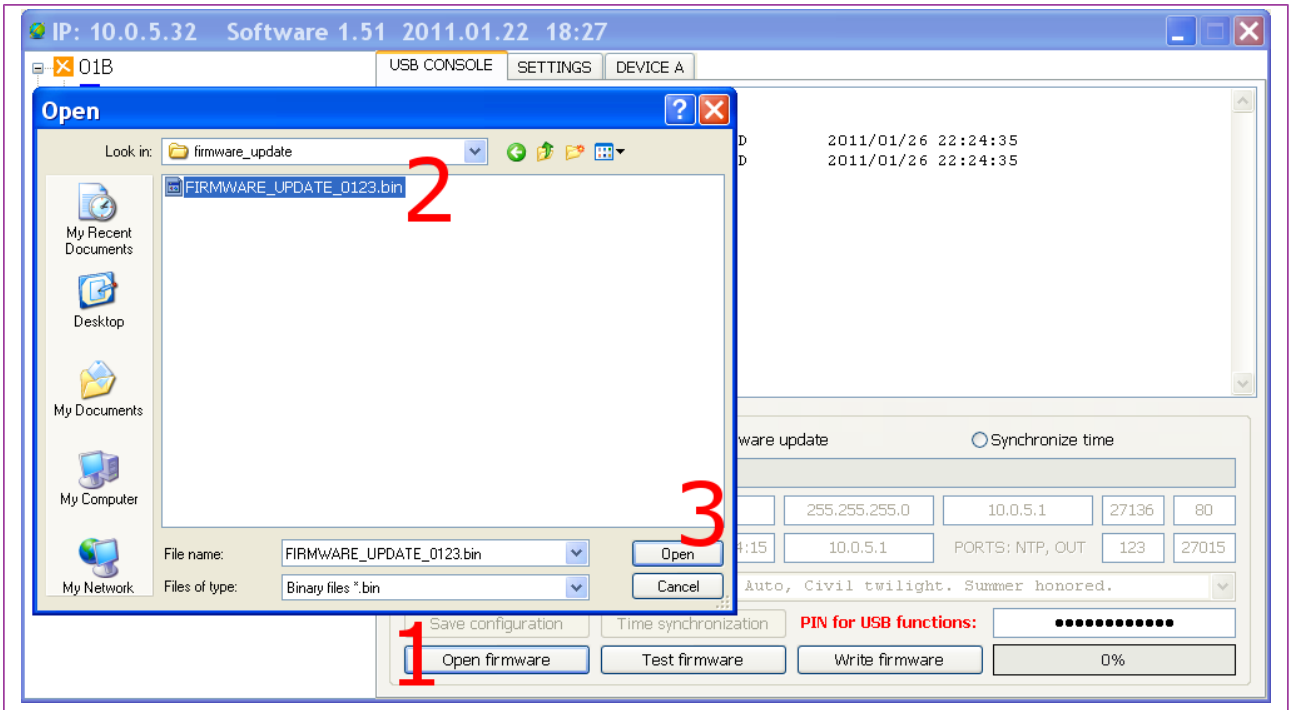
6. Do not press the 'ENTER' button on your keyboard, it's enough if you just type it in



7. Next, press the **Open firmware** button and find the firmware update file

8. The file has a '*.bin' extension. If you received a '*.rar' or '*.zip' file, you must extract it first

9. Select and open the firmware update file

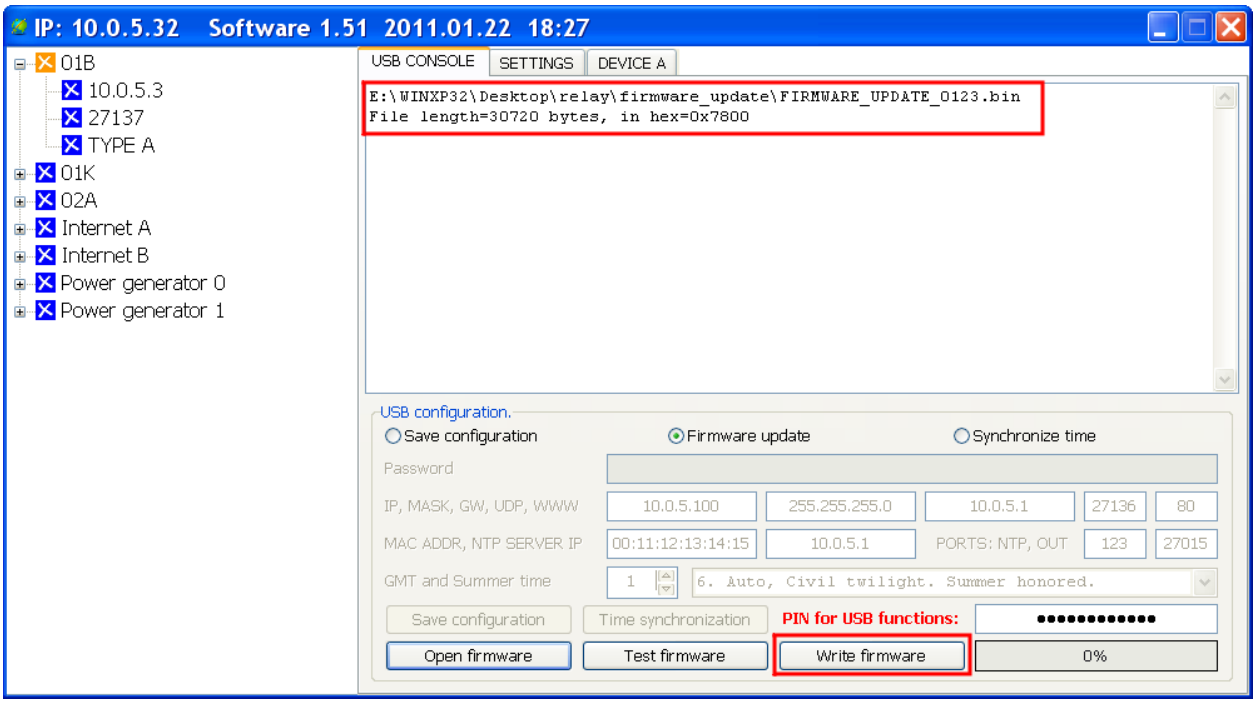


10. The firmware update file will be loaded

11. The file's path and size will be displayed in the console window

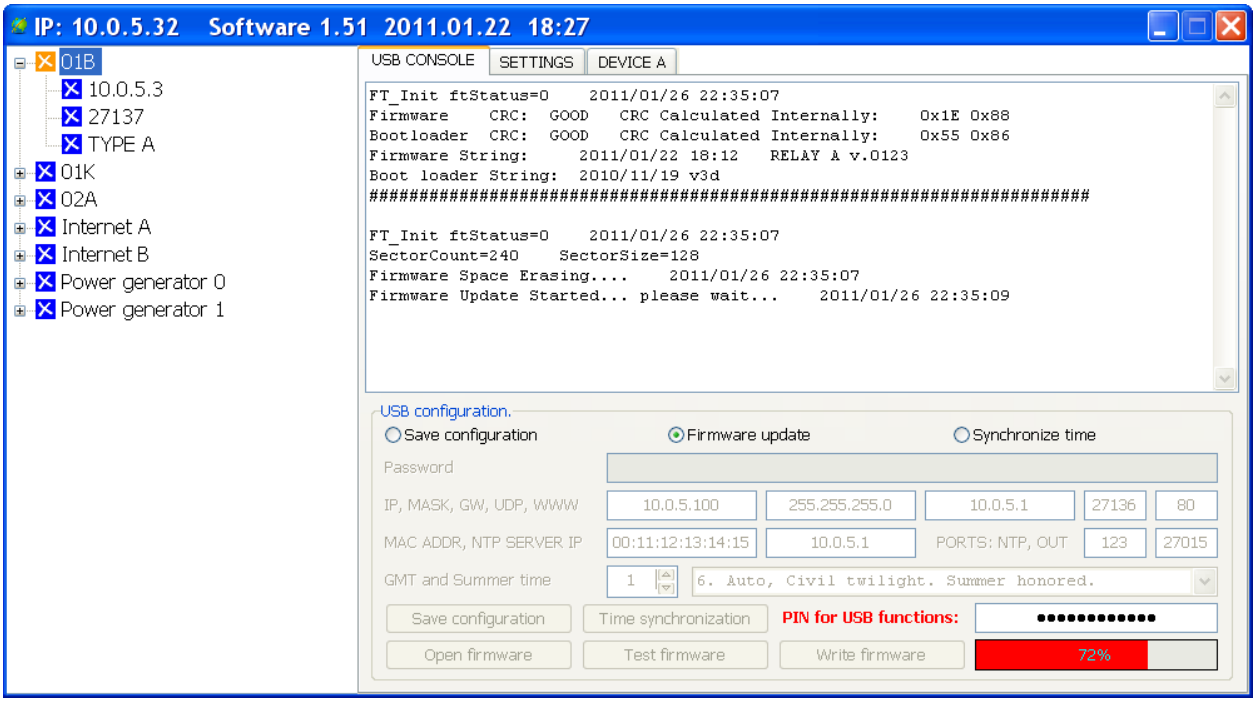
12. Next, you need to write the loaded file

13. Press the **Write firmware** button marked red on the picture below



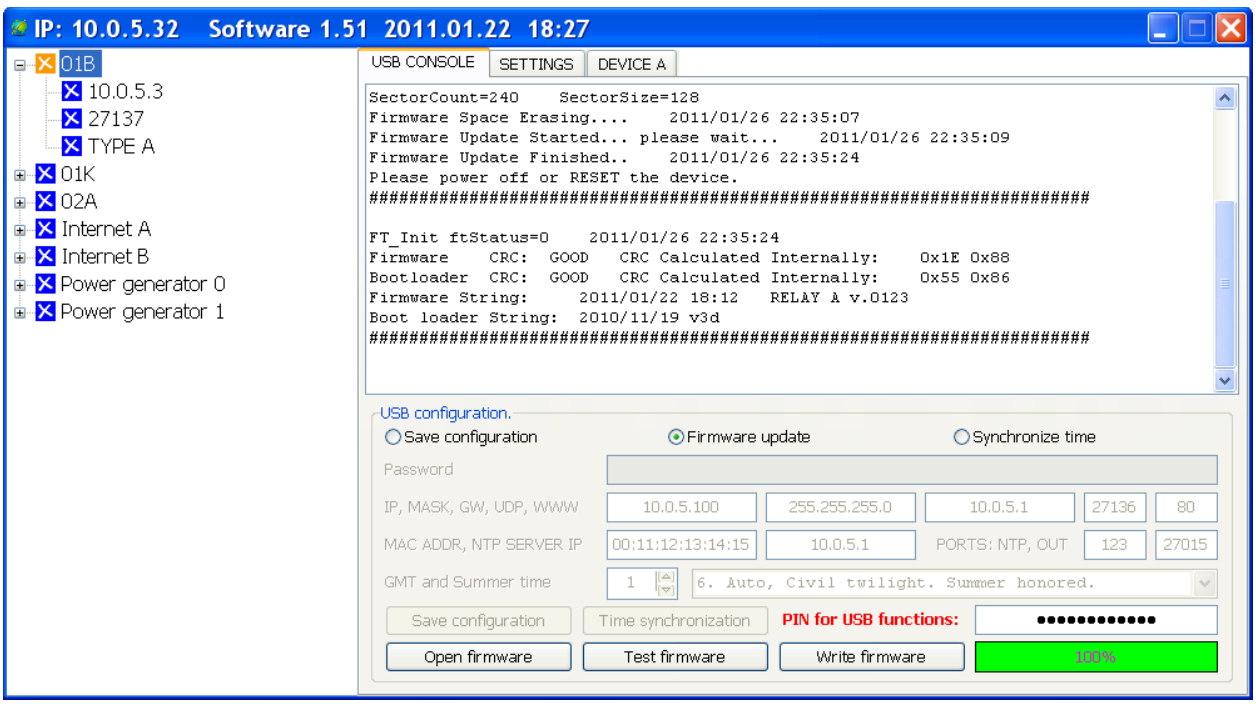
14. When you press the **Write firmware** button, the update will start.

You can view it's progress on a bar in the lower right corner. During update, the progress bar changes color from gray to red. The progress is measured in '%'.



15. When the update is finished, the progress bar will change color to green.

16. The console will display information about the update being finished and the version of the new firmware.



17. **After you update the firmware, you need to reset the device**

18. Press the **RESET** button on the front panel

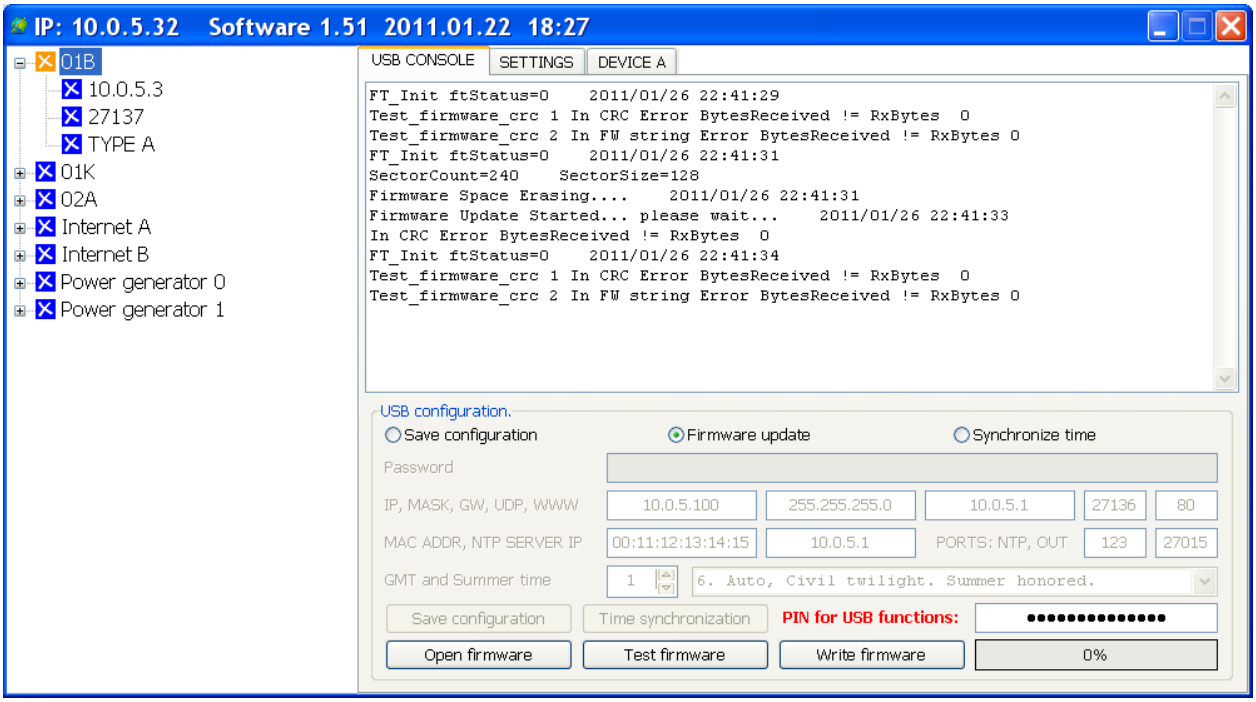
19. All three LEDs will switch on, then the red one will stay on for a short time

20. The device is ready for normal operation

THE FIRMWARE UPDATE PROCEDURE IS THE SAME FOR THE PLC2011A1 CONTROLLER, THE PLC2011B1 ALARM AND PLC2011C1 CONTROLLER.

24.3. Errors during firmware update

If an error message, similar to the one on the picture below, is displayed after you press the **Write firmware** button, it means that:



1. You did not enter the device into firmware update mode or

2. You did not enter the PIN code correctly

Repeat both of these operations.

25. ADDITIONAL FUNCTIONS

25.1. ICT defense of switched on computers

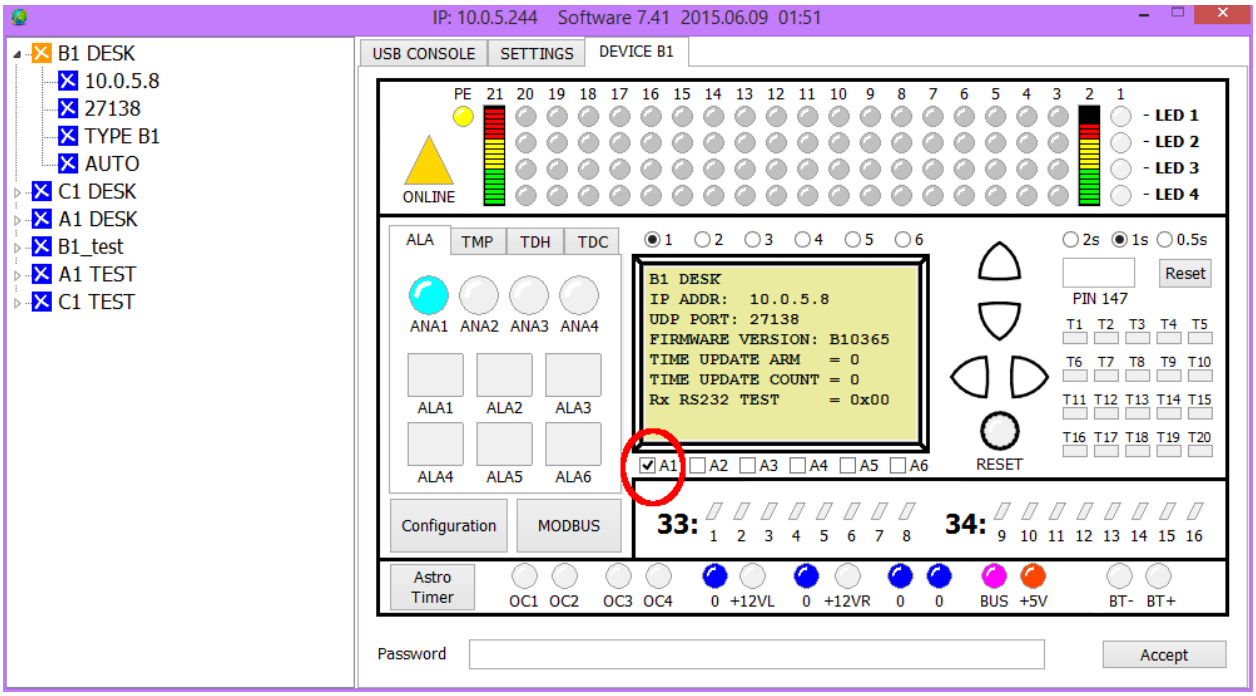
The newest function, implemented in the PLC2011B0 alarm and it's PC software as of the 5.25 version, is ICT defense of switched on computers. Let's say you exit a room leaving a computer running, you lock the door and arm the alarm zone for this room. Very often there are situations where you must leave your computer running while you are absent e.g. uploading a huge movie to YouTube or simply downloading something. In these situations you forget that other data in your computer are not protected in any way and anybody can walk up to your computer and view your files or steal your computer together with confidential data or projects.

When the computer is placed in a room with an armed alarm it is not that simple to sit down and browse or copy the files. An alarm siren will switch on immediately. Even if the hard drive is encrypted using TrueCrypt or similar software then a running computer is vulnerable anyway as it is on and the password is entered. In case of a laptop an external energy source isn't even needed as the battery will last enough to get to a potential adversary's house. In such case that person can simply enter a room using brute force and take an unprotected computer and it makes no difference if you use encryption software or not.

We have a method for that.

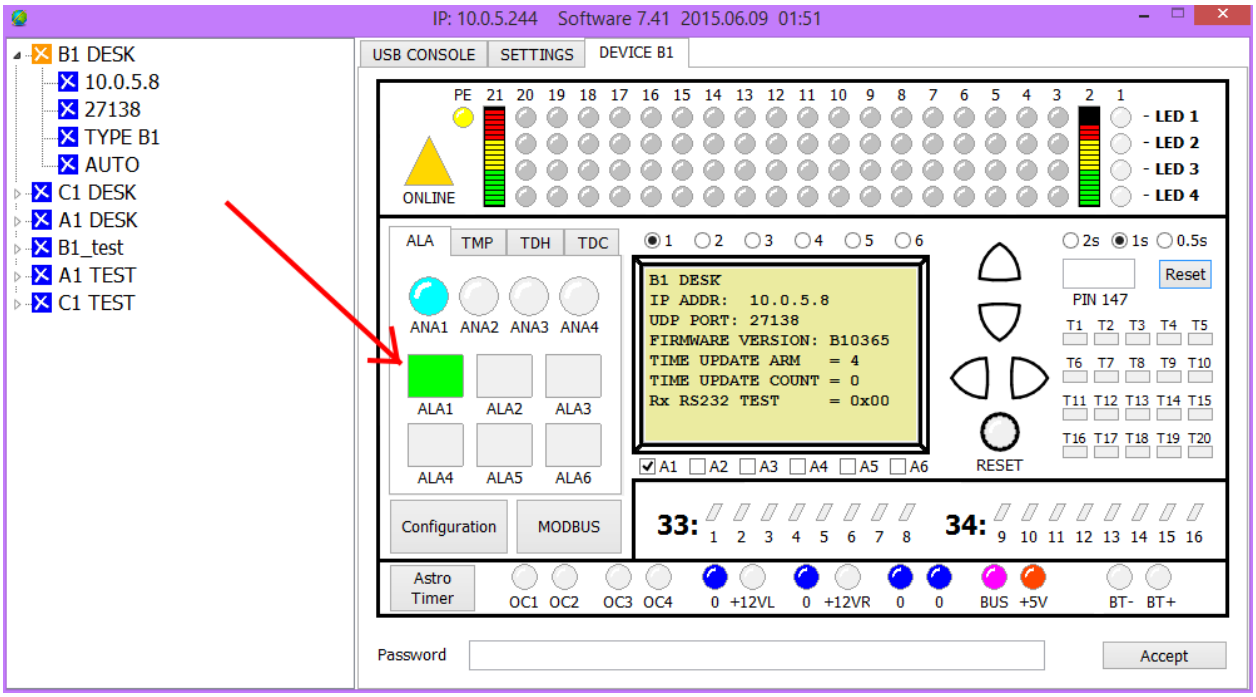
For the drive encryption software to work and our data to be safe the computer must be switched off fast after detecting an intruder. The faster your computer begins to close the better and the system closing procedure must be done correctly so that the encryption software can clear keys and entered passwords from it's buffer and the computer's RAM memory loses power supply as fast as possible.

It is enough that you pick an alarm zone which you want to be monitored to detect an alarm. In the example below A1 under the display will be alarm zone 1.



Next, double click the middle of the display so that the software hides to tray – the place near the clock. This condition has to be fulfilled. For the function to be active you need to tick the chosen alarm zone and hide the software to tray – necessarily by double-clicking the display.
Minimizing to the taskbar will not arm this function.

Next you should exit the room, lock the door and arm at least this alarm zone. You can do this using a phone with Android, tablet, another computer, switch on the wall etc.



When alarm zone 1 is triggered (or any chosen zone combination) then the computer will instantly start to close the system.

It will be impossible for an adversary to switch the computer on again as it's hard drive will be encrypted and the computer will ask for a password. Also installing and trying to read the drive in another computer will not be successful as the data will still be encrypted.

The last thing is to set a password for your computer's BIOS so that the adversary cannot run his own operating system in a short time after closing the operating system. You call it assigning a password or PIN to BIOS.

This way you can secure up to 20-30 computers in one LAN network.
If the software loses communication with the PLC2011B0 alarm then the system closing procedure will also be started and the system will be closed just in case.

As the software's communication with PLC2011B0 is heavily encrypted using the AES-256 algorithm, packets are additionally time stamped so an attack by trying to pose as the alarm is highly improbable. Of course you should consider possible dangers, placement of alarm sensors on other details by yourself.

For this function to be active on some computers the software needs to be run in the administrator mode.

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